DR. DEAN LEWIS
JOHNS HOPKINS HOSP
BALTIMORE

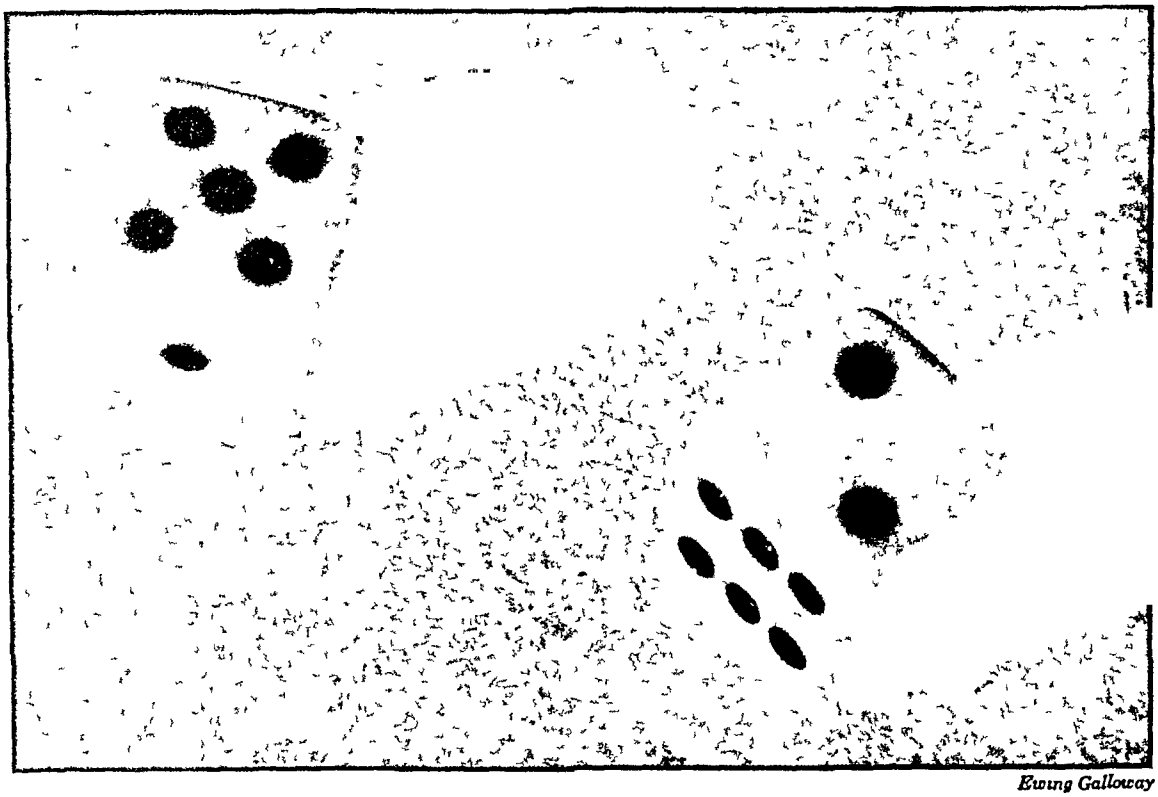
ANNALS of SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

VOL. 107
JUNE
1938
NO. 6

J. B. LIPPINCOTT COMPANY

A LUCKY BREAK!



Ewing Galloway

IT'S a lucky break for the patient when the surgeon decides to operate *under NEOcaine*

NEOcaine is the Spinal Anesthetic which Labat used for 17 years without a death It is especially indicated for poor surgical risks because of its extremely low toxicity

Many important hospitals insist upon use of NEOcaine for Spinal Anesthesia This is due to the fact that leading surgeons have discovered that this drug is not only the *least toxic* of any employed for the purpose, but also the *simplest* and *safest*

Spinal Anesthesia with NEOcaine affords perfect abdominal relaxation resulting in a smoother operation In addition, it contributes to quicker recovery with minimum shock and nausea

Technique is exceedingly simple assuring satisfactory anesthesia The spinal fluid is allowed to drop directly into the NEOcaine ampoule, dissolving the pure crystals, and then slowly injected with or without barbotage

Supplied in ampoules of 0 05, 0 08, 0 10, 0 12, 0.15, 0.20 and 0.30 Gm., in boxes of 10 ampoules.

Write today for new pamphlet summarizing recent valuable papers on Spinal Anesthesia

NEOCAINE

FOR SPINAL ANESTHESIA

ANGLO-FRENCH DRUG CO. (U. S A) INC

1270 Broadway - New York, N Y

VOL 107 JANUARY, 1938 NO 1

ANNALS of SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

Also the Official Publication of the American Surgical Association and the Southern Surgical Association

EDITORIAL BOARD

WALTER E LEE, M D
Chairman, *Philadelphia*

BARNEY BROOKS, M D
Nashville, Tenn

EDWARD D CHURCHILL, M D
Boston, Mass

ROSCOE R GRAHAM, M D
Toronto, Canada

SAMUEL C HARVEY, M D
New Haven, Conn

ROY D McCLURE, M D
Detroit, Mich

GEORGE P MULLER, M D
Philadelphia

H C NAFFZIGER, M D
San Francisco, Cal

DALLAS B PHEMISTER, M D
Chicago, Ill

W F. RIENHOFF, JR , M D
Baltimore, Md

A O WHIPPLE, M D
New York

JAMES TAFT PILCHER, B A , M D , Managing Editor

J B LIPPINCOTT COMPANY, *Publishers*
PHILADELPHIA MONTREAL LONDON NEW YORK

Entered at the Post Office at Philadelphia and admitted for transmission through the mails at second class rates Price $10 00 a year Copyright 1938, by J B Lippincott Company, 227–231 South Sixth Street Printed in U S A

CONTENTS

Vol 107 JANUARY, 1938 No 1

FURTHER CLINICAL EXPERIENCES WITH NINETY-FIVE PER CENT OXYGEN FOR THE ABSORPTION OF AIR FROM THE BODY TISSUES
Jacob Fine, M D
Louis Hermanson, M D
Stanley Frehling, M D
Boston Mass 1

RESULTS IN THE OPERATIVE TREATMENT OF MAJOR TRIGEMINAL NEURALGIA
Francis C Grant, M D
Philadelphia Pa 14

SPASMODIC TORTICOLLIS TREATED BY THE PLASTIC REDUCTION OF MOTOR FIBERS OF THE SPINAL ACCESSORY NERVE
Clement B Masson, M D
New York N Y 20

COMPLETE SYMPATHETIC DENERVATION OF THE UPPER EXTREMITY
Albert Kuntz, M D , Ph D
William F Alexander, M S
St Louis Mo
Charles L Furcolo, M D
Springfield Mass 25

THE PROPHYLACTIC AND ACTIVE USE OF ZINC PEROXIDE IN FOUL SMELLING MOUTH AND NECK INFECTIONS
Frank L Meleney, M D
New York N Y 32

GLOSSITIS RHOMBICA MEDIANA
Hayes E Martin, M D
M Elizabeth Howe, M D
New York N Y 39

PLASTIC RECONSTRUCTION OF THE ESOPHAGUS
Carl Eggers, M D
New York N Y 50

INFLAMMATORY TUMORS OF THE GASTRO-INTESTINAL TRACT
Guilford S Dudley, M D
Laurence Miscall, M D
New York N Y 55

NONSPECIFIC GRANULOMATA OF THE INTESTINE
Ralph Colp, M D
New York N Y 74

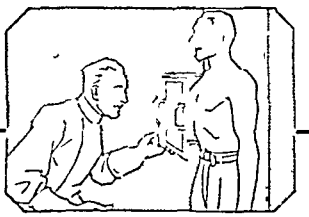
THE SO-CALLED HEPATO-RENAL SYNDROME
John H Garlock, M D
Samuel H Klein, M D
New York N Y 82

TUMORS VENTRAL TO THE SACRUM
Lorin D Whittaker, M D
John deJ Pemberton, M D
Rochester Minn 96

INTRAMEDULLARY DERMOID CYST
F Keith Bradford, M D
Chicago Ill 107

TEARS OF THE SUPRASPINATUS TENDON
Tom A Outland, M D
Walter F Shepherd, M D
Sayre Pa 116

(Contents continued on page 4)



Practically All Leading Roentgenologists

NOW USE THE PATTERSON TYPE B FLUOROSCOPIC SCREEN

THIS SCREEN has proved to be such a decided improvement over all previous fluoroscopic screens that it is now used by practically every leading roentgenologist In fact, every user with whom we have been in contact has expressed the opinion that from every standpoint the Patterson Type B is far ahead of all other fluoroscopic screens which they have used

Much greater brilliancy, increased contrast, and operation at lower voltages are among the advantages of this screen It reduces exposure factors, which protects the patient as well as the tubes and equipment

If you have not as yet experienced the advantages of this superior fluoroscopic screen it would pay you to ask your dealer for a demonstration

NEW AND HELPFUL INFORMATION
The following new Patterson Leaflets are now available (1) Cassette Contact, (2) Care of Intensifying Screens, (3) Patterson Mounting Paste and Method of Mounting Intensifying Screens Send for any in which you are interested

THE PATTERSON SCREEN CO , TOWANDA PA

Patterson

INTENSIFYING **Screens** FLUOROSCOPIC

SCREEN SPECIALISTS FOR MORE THAN TWENTY YEARS

Please mention ANNALS OF SURGERY when writing advertisers

CONTENTS—*Continued*

DUPUYTREN'S CONTRACTURE — A Bruce Gill, M D, Philadelphia Pa — 122

GLOMUS TUMOR — Anatole Kolodny, M D, New York N Y — 128

INTERNAL FIXATION FOR RECENT FRACTURES OF THE NECK OF THE FEMUR — Melvin S Henderson, M D, Rochester Minn — 132

BRIEF COMMUNICATIONS AND CASE REPORTS

A METHOD OF REDUCING LARGE DIAPHRAGMATIC HERNIA FROM ABOVE — Harry G Sloan, M D, Cleveland Ohio — 143

ACUTE INFLAMMATORY JEJUNITIS WITH INTESTINAL OBSTRUCTION — 147

COLECTOMY FOR CHRONIC ILEOCOLITIS — 148

CHRONIC INFLAMMATORY TUMOR OF THE MESENTERY — Percy Klingenstein, M D, New York N Y — 151

OBSTRUCTION DUE TO APPENDICES EPIPLOICAE — Carl Baumeister, M D, Council Bluffs Iowa; C W Horgens, M D; C F Morsman, M D, Hot Springs S Dak — 153

GUNSHOT WOUND OF RIGHT ILIAC BONE — Sigmund Mage, M D, New York N Y — 155

MEMOIR

FRANCIS ALEXANDER CARREL SCRIMGER — Edward W Archibald, M D — 159

do you treat
CANCER?

THE RADIUM EMANATION CORPORATION

MAINTAINS the most efficiently organized Radium laboratory to make available to you, at low cost, every facility for the use of Radium in your practice

RADON SEEDS Removable or permanent We provide seeds of the composite type, with Radon under leak-proof glass seal Filtration 0 3 mm of Platinum

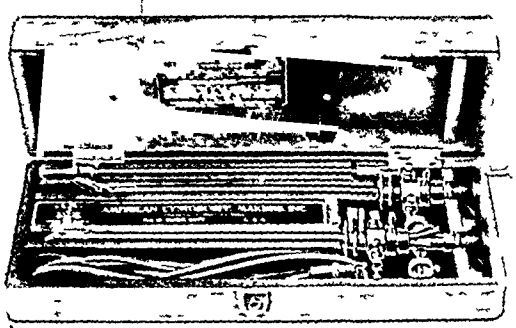
APPLICATORS Uterine tubes, cervical applicators, surface plaques properly prepared to meet the requirements of each individual case

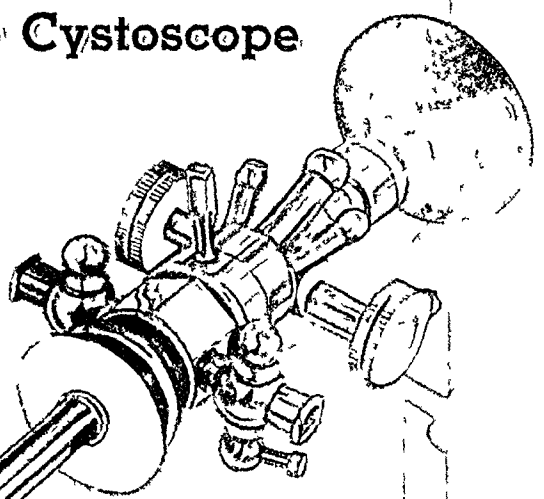
OUR SERVICE is available to you day and night including Sundays and holidays Your inquiries and orders will receive our prompt and careful attention

THE RADIUM EMANATION CORPORATION

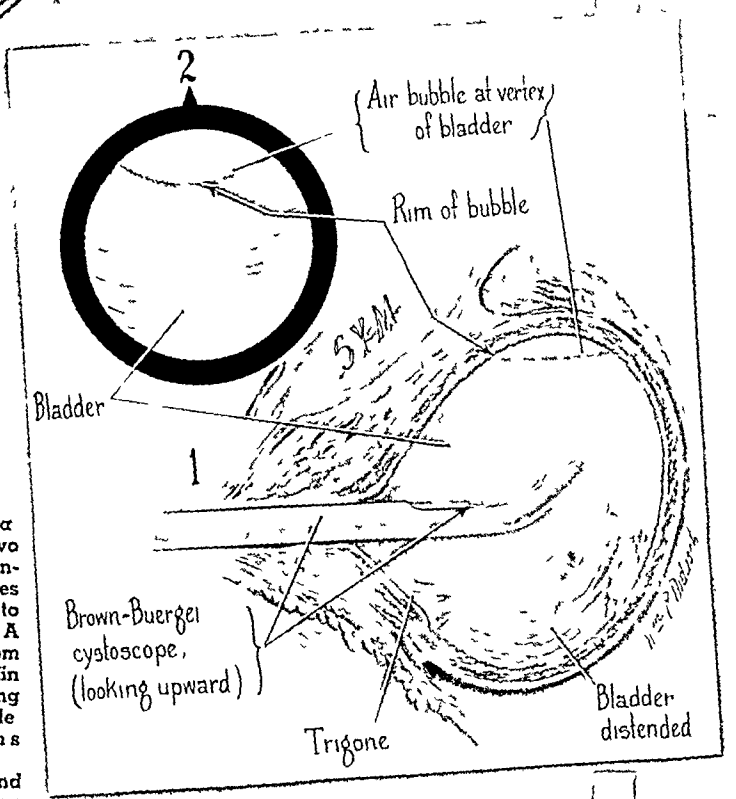
GRAYBAR BLDG **Tel MOhawk 4-6455** **NEW YORK, N Y**

Brown-Buerger Convertible Cystoscope





The illustration is part of a series admirably executed by Mr William P Didusch showing the technique of the Brown Buerger cystoscopes The entire series and a complete description of the instrument and its accessories will be furnished upon request



The Brown Buerger Convertible Cystoscope catalogue No 120 consisting of two telescopes and two sheaths comprises a relatively complete armamentarium which represents an economy in cystoscopes for those who do not object to taking the time to change the fins* when converting the telescope A detachable fin permits converting this telescope from catheterizing to operating type since with the fin removed the telescope can be used for operating instruments through its identifying center guide With the fin attached in place it divides the sheath s lumen to form tunnels for the two catheters

This instrument is now made in two sizes 24 and 21 Fr The smaller size represents a new addition to the line through popular demand and while somewhat limited in scope is useful where the patient s comfort is a prime consideration

* The necessity for removing the fin has been reduced with this instrument thru the use of our new small flexible forceps which will pass through the catheter channels

ESTABLISHED IN 1900 BY REINHOLD H WAPPLER

AMERICAN CYSTOSCOPE MAKERS, INC.

FREDERICK C WAPPLER PRESIDENT

450 WHITLOCK AVE NEW YORK U S A

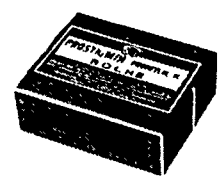
POSTOPERATIVE COMFORT



in the hollow of your hand

PROSTIGMIN PROPHYLACTIC safeguards against the appearance of gas-pains and distention following laparotomies It provides an easy, efficient method of maintaining intestinal tone without hyperperistalsis The by-effects that may follow injection of peristaltic stimulants are conspicuous by their absence

Summarizing a report of 249 cases (*Western Journal of Surgery, Gynecology, and Obstetrics,* 45 458) the author said, in part, the following "The feeling of security which its use gives to both patient and surgeon, and the fact that it has been found to be an effective prophylactic against distention resulted in the use of Prostigmin being made a routine procedure in the surgical division of this hospital"



PROSTIGMIN PROPHYLACTIC, ampuls, 1 cc (1 4000 solution) Usual schedule of administration 1 ampul every 6 to 8 hours, beginning 24 hours before operation, until the critical period is passed

PROSTIGMIN REGULAR, ampuls, 1 cc (1 2000 solution) For *treatment* of distention and ileus 1 to 2 ampuls p r n

HOFFMANN-LA ROCHE • INC • NUTLEY • N J.

Please mention ANNALS OF SURGERY when writing advertisers



JOHN HUNTER (1728-1793) obtained much of the experience on which his "A Treatise on Blood Inflammation and Gunshot Wounds" was based while serving as staff naval surgeon during the war with France. In 1776 he was appointed Surgeon Extraordinary to the King and in 1785 performed his first ligation of the femoral artery in Hunter's Canal for popliteal aneurism. The old operation had proved unsatisfactory and this improvement of Hunter's was a significant contribution to surgery.

D&G Sutures

"THEY ARE HEAT STERILIZED"

DAVIS & GECK INC

Special D&G Sutures

WITH SWAGED-ON ATRAUMATIC NEEDLES

●

THIS group of products comprises over a hundred suture and needle combinations specially designed for specific procedures, particularly those in which minimized suture trauma and the convenience of needles which cannot possibly become unthreaded, are desirable. A few products from this group are shown on these pages. Full information on others may be obtained from your dealer or by mail from us, upon request.

Intestinal Sutures

KALMERID plain or chromic catgut, celluloid-linen or silk with Atraumatic needles in the several types indicated integrally affixed. Suture lengths 36 inches for products 1342, 1352, 1372 and 1542, all others 28 inches.

THERMO-FIL *(non-boilable)*

Plain Catgut

NO		NEEDLE	DOZEN
1501	Straight Needle	A-1	$3 60
1503	3/8-Circle Needle	A-3	4 20
1504	Small 1/2-Circle Needle	A-4	4 20
1505	1/2-Circle Needle	A-5	4 20

20-Day Chromic Catgut

1541	Straight Needle	A-1	$3 60
1542	Two Straight Needles	A-1	4 20
1543	3/8-Circle Needle	A-3	4 20
1544	Small 1/2-Circle Needle	A-4	4 20
1545	1/2-Circle Needle	A-5	4 20

CLAUSTRO-THERMAL *(boilable)*

Plain Catgut

1301	Straight Needle	A-1	$3 60
1303	3/8-Circle Needle	A-3	4 20
1304	Small 1/2-Circle Needle	A-4	4 20
1305	1/2-Circle Needle	A-5	4 20

20-Day Chromic Catgut

1341	Straight Needle	A-1	$3 60
1342	Two Straight Needles	A-1	4 20
1343	3/8-Circle Needle	A-3	4 20
1344	Small 1/2-Circle Needle	A-4	4 20
1345	1/2-Circle Needle	A-5	4 20

Intestinal Sutures *(cont'd)*

Celluloid-Linen

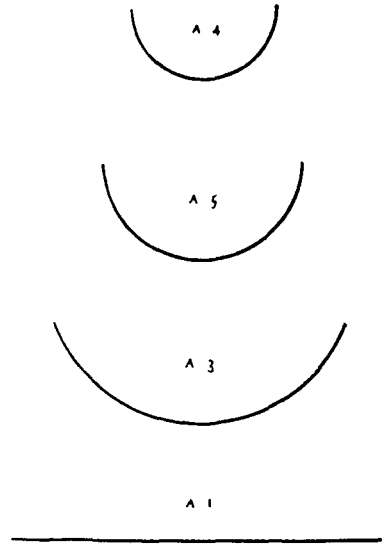
NO		NEEDLE	DOZEN
1351	Straight Needle*	A-1	$3 60
1352	Two Straight Needles*	A-1	4 20
1354	Small 1/2-Circle Needle*	A-4	4 20

Black Silk

1371	Straight Needle*	A-1	$3 60
1372	Two Straight Needles*	A-1	4 20
1374	Small 1/2-Circle Needle*	A-4	4 20

Sizes 00 0 1, except *00 0 only

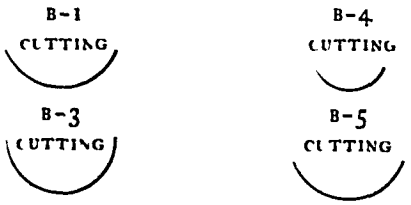
In packages of 12 tubes of a kind and size



DIAMETERS .02 TO .06

Eye Sutures

FINE sizes of plain, 10-day chromic catgut, and black silk with small Atraumatic needles Suture length 18 inches except as noted Boilable

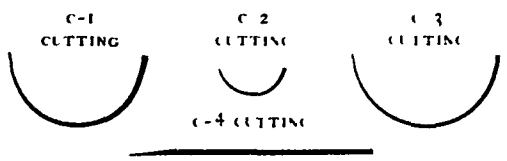


NO	MATERIAL	SIZE	NEEDLE
1661	Black Silk	6-0	B-3
1663	Plain Catgut	4-0	B-5
1665	Black Silk	6-0	B-1
1665	Black Silk	4-0	B-1
1667	Plain Catgut	3-0	B-4
1669	10-Day Catgut	4-0	B-5
1669	10-Day Catgut	3-0	B-5
1669D	10-Day Catgut †	4-0	B-5
1669D	10-Day Catgut †	3-0	B-5
	DOUBLE ARMED		
1662	Black Silk *	6-0	B-3
1664	Black Silk *	6-0	B-1
1664	Black Silk *	4-0	B-1
1666	Plain Catgut *	3-0	B-4
1668	10-Day Catgut *	4-0	B-5
1668	10-Day Catgut *	3-0	B-5
1668D	10-Day Catgut †	4-0	B-5
1668D	10-Day Catgut †	3-0	B-5

* 12 inches † 9 inches

Package of 12 tubes of a kind $4 20

Cleft Palate and Harelip Sutures



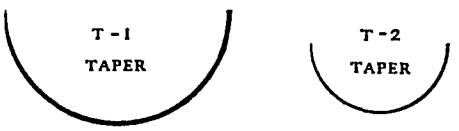
NO	MATERIAL	SIZE	NEEDLE
1751	Kal-dermic	00	C-1
1752	Aluminum-Bronze Wire	00	C-1
1753	Black Braided Silk	000	C-2
1754	Aluminum-Bronze Wire	00	C-4
1755	Kal-dermic	00	C-3
1758	Aluminum-Bronze Wire	00	C-3

Suture length 18 inches

Package of 12 tubes of a kind $4 20

Thyroid Sutures

THERMO-FLEX (*non-boilable*) or Claustro-Thermal (*boilable*) catgut, and black braided silk with half-circle, taper point Atraumatic needles Suture length 28 inches



NO	MATERIAL	SIZE	NEEDLE
1635	Non-Boilable Plain Catgut	0	T-1
1625	Boilable Plain Catgut	0	T-1
1624	Black Braided Silk	000	T-2

Package of 12 tubes of a kind $4 20

Plastic Sutures

FINE sizes of Kal-dermic, silk and silkworm gut with small, cutting point Atraumatic needles Suture length 18 inches Boilable



NO	MATERIAL	SIZE	NEEDLE
1651	Kal-dermic	8-0	B-1
1651	Kal-dermic	6-0	B-1
1652	Kal-dermic	8 0	B-5
1652	Kal-dermic	6-0	B-5
1652	Kal-dermic	4-0	B-5
1653	Black Silkworm	4-0	B-1
1655	Kal-dermic	4-0	B-2
1658	Black Silk	4-0	B-2

Package of 12 tubes of a kind $4 20

Other D & G Sutures

SPECIAL needled sutures are also prepared for dental, tonsil, circumcision, obstetrical, ureteral, renal, nerve, artery, and emergency work These are in addition to our complete line of unneedled sutures embracing catgut, ribbon gut, kangaroo tendons, and a variety of other non-absorbable materials

DISCOUNTS ON QUANTITIES

DAVIS & GECK, INC , 217 DUFFIELD STREET, BROOKLYN, NEW YORK

Copyright 1938 Davis & Geck, Inc Printed in U S A



"A balance of qualities..."

NEW types and varieties of sutures are constantly needed to meet advances in surgery, but the fundamentals of suture dependability remain unchanged

Sutures still should be not only easy to handle but correct in every phase of behavior No single feature nor point of merit can accomplish this it demands a *combination* of various qualities

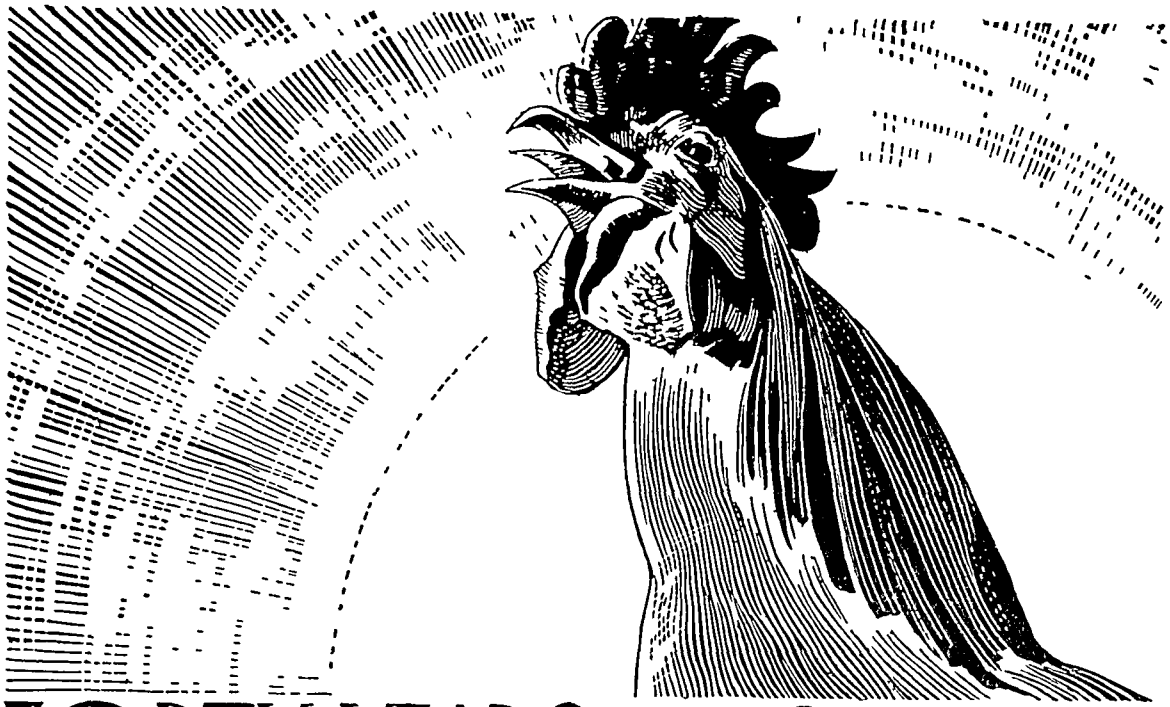
Therefore, in every new product and in every development by our scientific staff the first concern is a proper ratio of vital characteristics

The special feature of each product is developed to the highest degree, but always with due regard to other qualities equally essential to correct function

This policy, which involves the annual consumption of more than 250,000 tubes in experimental work and tests, gives assurance that D & G Sutures invariably possess the correct *balance of qualities*

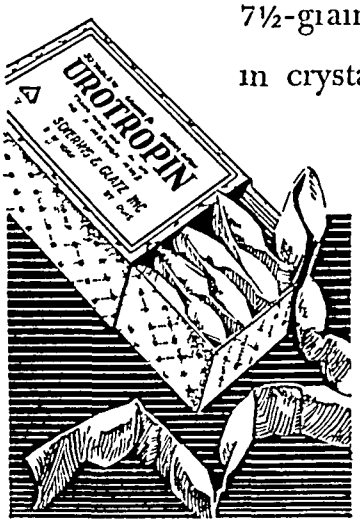
D & G Sutures

DAVIS & GECK, INC - - BROOKLYN, NEW YORK, U S A



FORTY YEARS *is a Long Time....*

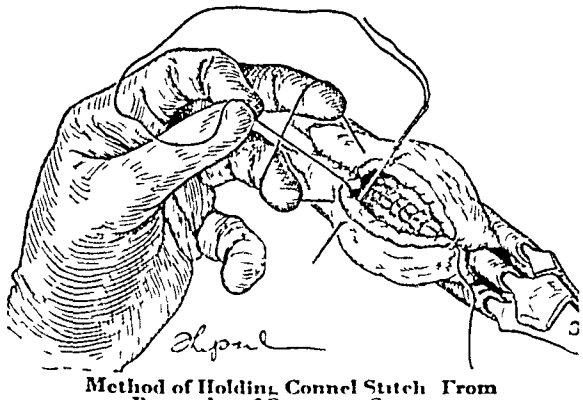
Therapeutic products have come and gone—but Urotropin has survived on merit alone That is something to "crow about" Today, Urotropin still retains the esteem of physicians as a urinary antiseptic which, used properly, is effective often where other measures have failed Urotropin is a brand of methenamine, its purity guaranteed by Schering & Glatz, Inc Supplied in sanitape protection in 5-grain tablets, 30 in a box, 7½-grain tablets, 20 in a box Also in larger packages, and in crystals A trial supply may be obtained by physicians



UROTROPIN

SCHERING & GLATZ, INC
113 West 18th Street New York City

Actual Practice in Surgical Technique



Method of Holding Connel Stitch From Principles of Operative Surgery, by A V Partipilo, M D

CHICAGO POST-GRADUATE SCHOOL OF SURGERY

(Formerly—Laboratory of Surgical Technique)

(Incorporated not for profit)

Near Cook County Hospital

1 Two Weeks Surgical Technique Course rotary course continued throughout the year Combines Clinical Teaching and ACTUAL PRACTICE BY THE STUDENTS under competent supervision A review of the necessary Surgical Anatomy is embraced in the work

2 General Surgery One to Three Months Course designed for students who wish to review more thoroughly Anatomy Surgical Pathology Surgical Technique, and Clinical Surgery

3 Special instruction and practice in the technique of one or more operations is available to surgeons who wish to review the Anatomy and Technique of certain operations

Special Courses—

Urology Cystoscopy Orthopedic Surgery Thoracic Surgery Surgical Pathology Laboratory Diagnosis and Technique Bronchoscopy Eye, Ear Nose, and Throat Goiter Surgery Gynecology Surgical Anatomy Proctology

Visitors always welcome

Personal Instruction Actual Practice Operating Rooms, Equipment and Method of Teaching Ideal and Unsurpassed For information as to Courses, Fees, Registration Requirements, Etc, address

A V PARTIPILO, M D, F A C S, Director, 1950 S Ogden Ave, Chicago Ill, Phone Haymarket 7044

NEO-PLASMOID



for Injection Treatment of Hernia

Produces prompt proliferation of tissue without causing ulcers, sloughs, abscesses or brittle scar tissues One 30 cc vial, $3 50, serves 2 or 3 patients Write for simplified technique

FARNSWORTH LAB, 159 N State St, Chicago

Cook County Graduate School of Medicine

(In affiliation with COOK COUNTY HOSPITAL)
Incorporated not for profit

ANNOUNCES CONTINUOUS COURSES

MEDICINE—Informal Course Intensive Personal Courses, Special Courses

SURGERY—General Courses One Two Three and Six Months Two Weeks Intensive Course in Surgical Technique with practice upon living tissue Clinical Course Special Courses

GYNECOLOGY & OBSTETRICS—Diagnostic Courses Clinical Courses Special Courses

FRACTURES & TRAUMATIC SURGERY—Informal Practical Course Ten Day Intensive Course starting February 14 1938

OTOLARYNGOLOGY—Two Weeks' Intensive Course starting April 4 1938

OPHTHALMOLOGY—Two Weeks Intensive Course starting April 18, 1938 Personal Course in Refraction Methods

UROLOGY—General Course Two Months Intensive Course Two Weeks Special Courses

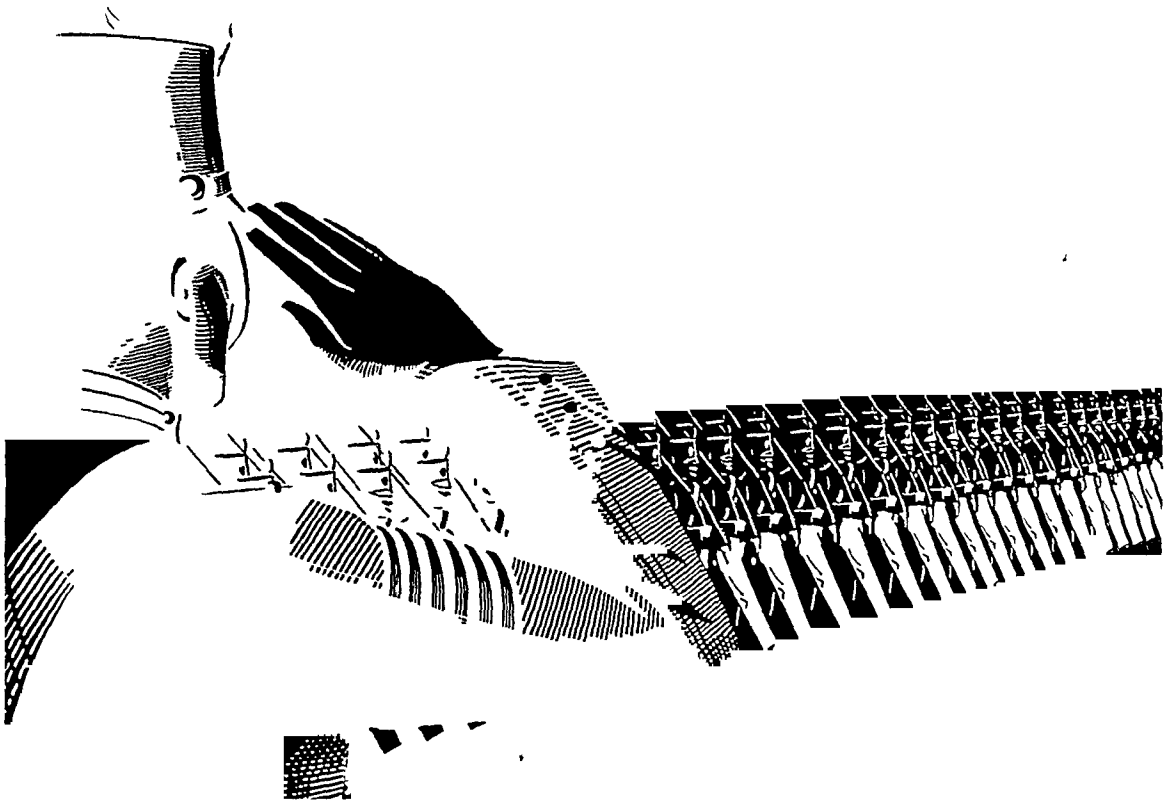
CYSTOSCOPY—Ten Day Practical Course

GENERAL INTENSIVE AND SPECIAL COURSES IN ALL BRANCHES OF MEDICINE AND SURGERY

TEACHING FACULTY

Attending Staff of Cook County Hospital

Address Registrar 427 South Honore Street
Chicago, Illinois



DISCIPLINE

'Discipline is the development of the faculties by instruction and exercise" When functions such as habit time of bowel movement are neglected through lack of discipline or intelligence, they require careful training to restore them to a normal state

Petrolagar has proved to be an agreeable and effective means of assisting in the establishment of bowel discipline Because Petrolagar mixes intimately with the bowel contents, it increases the bulk in the stool to a soft mass which is easily passed

Petrolagar is prepared in five types — providing the doctor with a variation of treatment to suit the individual patient Petrolagar Laboratories, Inc, Chicago, Ill

Petrolagar is a mechanical emulsion of pure liquid petrolatum (65% by volume) and agar agar Accepted by the Council on Pharmacy and Chemistry of the American Medical Association for the treatment of constipation

Petrolagar

ARE YOU SURE?



Armour Laboratories Assure Potency, Standardization, Dependability by Modern Scientific Techniques

SOME ARMOUR STANDARDIZATION METHODS

ARMOUR THYROID has been standardized on the Thyroxine Iodine content

ARMOUR PITUITARY LIQUID has been standardized on the *Guinea Pig Uterus* for its oxytocic potency

SOLUTION LIVER EXTRACT (ARMOUR) has been assayed on the *Red Cell Regeneration* counts in true Pernicious Anaemia cases

● Every glandular preparation must have three vital qualities before you can be sure of its effectiveness in your work It must be of high potency. It must be standardized carefully It must be thoroughly dependable

The Armour Laboratories protect and assure these vital qualities in their products To be certain of high, unvarying potency, they use only the best fresh raw materials . . process them without delay at the source of supply Armour preparations are standardized by the most modern, approved methods Their dependability is the result of scientific technique and reliable, up-to-the minute laboratory equipment We welcome the opportunity to show the facilities and processes of the Armour Laboratories to members of the medical profession

GLANOID TRADE MARK

THE ARMOUR LABORATORIES

Headquarters for Medicinals of Animal Origin

ARMOUR AND COMPANY **UNION STOCK YARDS · CHICAGO**

The Lilly Code

1 To provide the profession with medicinal products of highest quality and unvarying potency

2 To contribute to the progress of medicine by developing new and superior agents through research.

3 To issue information about the uses of the products of the company through professional channels exclusively

For the Attention of Surgeons

● *The Exacting Requirements of Surgery* are more than amply fulfilled by Tincture 'Merthiolate' (Sodium Ethyl Mercuri Thiosalicylate, Lilly) This antiseptic compares favorably with the best germicides in bactericidal and sustained bacteriostatic effects It is especially distinguished by its low toxicity to tissues and its applicability for preoperative skin disinfection and surgical dressing

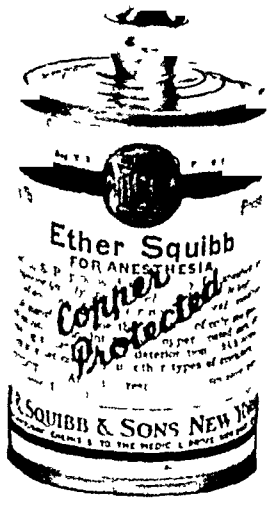
* * *

Tincture 'Merthiolate' (Sodium Ethyl Mercuri Thiosalicylate, Lilly) is supplied in four-ounce and one-pint bottles

ELI LILLY AND COMPANY

Principal Offices and Laboratories, Indianapolis, Indiana, U S A

THE



Obvious

CHOICE

• Ninety years of clinical experience have attested the safety, adaptability, and effectiveness of ether Hence it is obvious that it should be the most widely used anesthetic agent

Since the production of Squibb Ether is mechanically controlled by unerring, sensitive automatic gauges and packaged in patented copper-lined containers to prevent the formation of undesirable toxic substances, it follows that such an ether should be pure, uniform, and effective

Since Squibb Ether is used in over 85% of American hospitals and in millions of cases every year, it is apparent that surgeons and anesthetists have every confidence in its ability to produce safe, satisfactory anesthesia

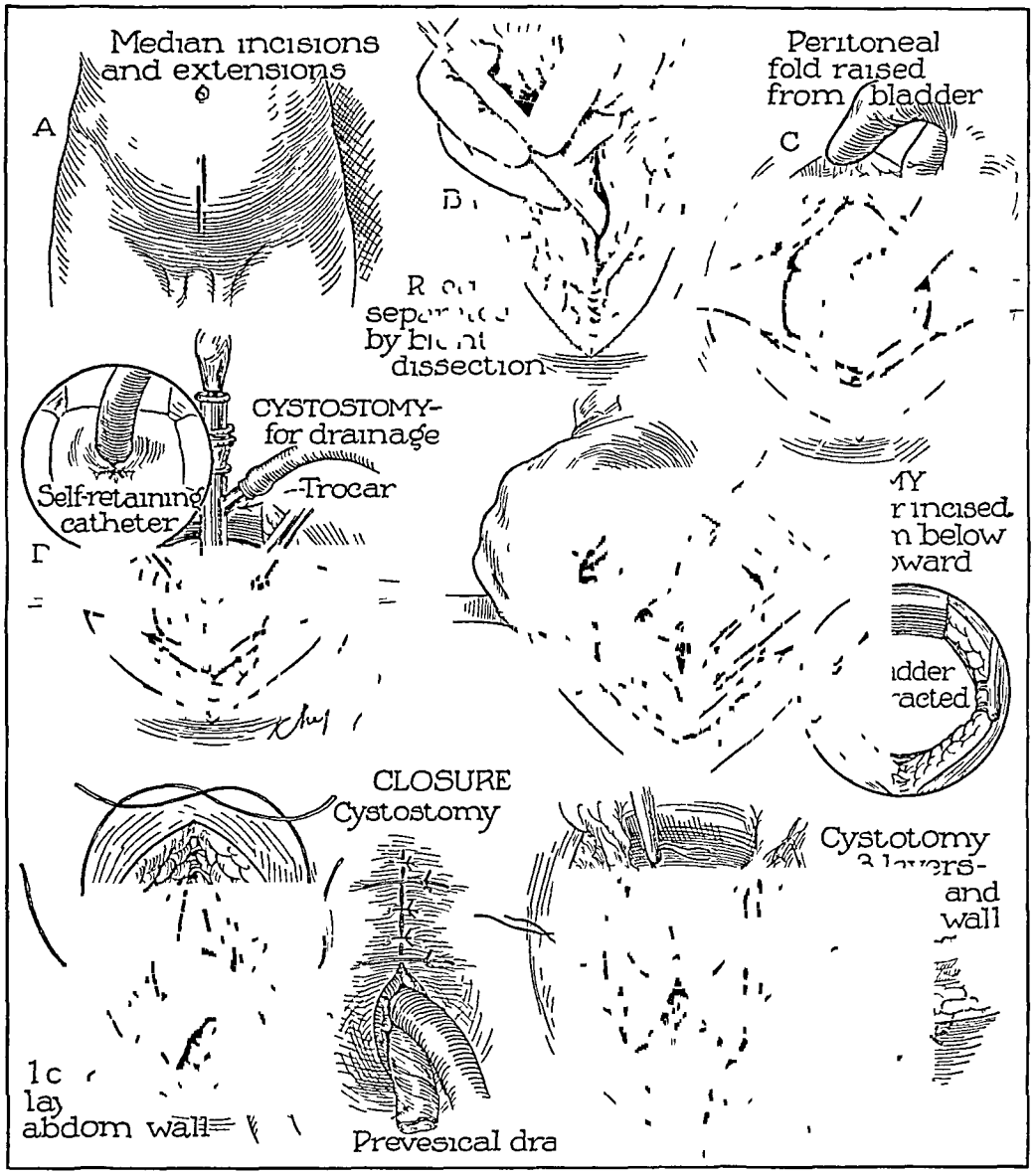
For literature address the Anesthetic Division,
E. R Squibb & Sons, 745 Fifth Ave., New York

SQUIBB ETHER

OPERATIVE PROCEDURE

PLATE NO 77

Suprapubic Cystostomy and Cystotomy



The Ethicon Suture series on Operative Procedure starts its eighth year with this issue Johnson & Johnson have received many splendid comments on this series from surgeons, and hope that in 1938 the drawings will again be found interesting and useful "Operative Procedure," Fifth Edition, a book of all the drawings published to date, is now ready Your request to the Professional Division will bring your complimentary copy

ETHICON NON-BOILABLE CATGUT SUTURES

JOHNSON & JOHNSON, NEW BRUNSWICK, N J , CHICAGO, ILL

MANUFACTURERS OF SURGICAL SUTURES SINCE 1887

Please mention ANNALS OF SURGERY when writing advertisers

Lukens Sterile Catgut

TRADE (Bartlett Process) MARK



Make the Test Yourself

Compare It Point for Point With any Other Catgut

We Will Send the Samples

Sizes 00-4 Plain

C. DE WITT LUKENS CO.
4908 Laclede Ave.
ST. LOUIS, MO., U.S.A.

Sizes 00-4 Tanned

"THIS ONE THING WE DO"



SUTURES

DAVIS & GECK Inc Brooklyn N Y

ANNALS OF SURGERY

VOL 107 JANUARY, 1938 No 1

FURTHER CLINICAL EXPERIENCES WITH NINETY-FIVE PER CENT OXYGEN FOR THE ABSORPTION OF AIR FROM THE BODY TISSUES*

JACOB FINE, M D , LOUIS HERMANSON, M D , AND STANLEY FREHLING, M D

BOSTON, MASS

FROM THE SURGICAL DEPARTMENT, BETH ISRAEL HOSPITAL AND THE DEPARTMENT OF SURGERY, HARVARD MEDICAL SCHOOL BOSTON MASS

WHEN atmospheric air accumulates in excessive quantities in body cavities or tissue spaces, it may become a noxious foreign body causing symptoms varying from a mild discomfort to alarming distress This is the situation in gaseous distention of the intestine, spontaneous pneumathorax, subcutaneous emphysema, air embolism and the immediate postencephalographic state The oxygen fraction of the air is rapidly absorbed, but the nitrogen fraction remains as the offending agent It disappears from the tissues very slowly because its diffusibility into the blood stream depends on the small difference between its partial pressure in the tissues (627 Mm Hg) and the blood[1] (573 Mm Hg)

The simple expedient of withdrawing the incarcerated nitrogen by needle and syringe can be effectively applied only in the case of pneumathorax We have, therefore, attempted to effect the removal of the nitrogen indirectly by lowering the tension of the nitrogen in the blood stream This is readily accomplished by supplanting the ordinary air which is breathed by 95 per cent oxygen Shaw[1] measured the fall in the partial pressure of nitrogen in the arterial blood during the inhalation of pure oxygen and found that after one hour this pressure is 155 Mm Hg , after two hours 91 Mm Hg , after three hours 52 Mm Hg and after four hours 31 Mm Hg Therefore, when pure oxygen† is breathed, the diffusion pressure existing between nitrogen in the tissues and that in the blood progressively increases, so that one should expect a corresponding increase in the speed of absorption of nitrogen from the tissues into the blood stream, whence it escapes into the expired air

In a previous communication[2] experimental evidence was offered confirming these theoretic considerations Cats, whose obstructed intestines were inflated with nitrogen, disposed of only 10 per cent of the original volume of gas when atmospheric air was breathed, whereas about 60 per cent disappeared in the same interval of time when pure oxygen was breathed Similar,

* The expenses of this investigation were defrayed by the DeLamar Mobile Research Fund, Harvard Medical School, Boston, Mass Submitted for publication March 25, 1937

† For practical purposes 95 per cent oxygen is adequate

though not accurately quantitated, results were observed in pneumaperitoneum and subcutaneous emphysema [1] It was pointed out furthermore that the time required to absorb a given volume of nitrogen from any body space "depends on the surface area of the gas bubble, since only that fraction in contact with an absorbing surface can enter the surrounding tissues and from there the blood capillaries For example, 500 cc of nitrogen in the intestine, the pleural cavity or the peritoneal cavity will presumably require a considerably greater interval of time for absorption than an equal volume dispersed as tiny bubbles throughout the body, as in caisson disease"

These observations have been applied to patients suffering from intestinal distention and from the symptoms immediately following encephalography The preliminary results were reported in two recent papers[4, 5] together with a description of an apparatus for the clinical administration of 95 per cent oxygen * In this report we are presenting further clinical experiences with 95 per cent oxygen in order to define more clearly its advantages and its limitations for the absorption of air from the body cavities and tissue spaces

INTESTINAL DISTENTION

Case 1—*Mesenteric Adenitis Postoperative Distention*—A male, age 12, two weeks before admission to the hospital had peri-umbilical pain accompanied by nausea and vomiting, which subsided in 24 hours The same symptoms recurred 11 days later, and the pain this time radiated to the right lower quadrant At celiotomy the only abnormal finding was acute mesenteric adenitis One node was removed for biopsy and appendicectomy was performed From the second to the fifth postoperative day he vomited once or twice daily He passed a slight amount of flatus occasionally but the abdomen became distended and he began to feel peri-umbilical, colicky pain A duodenal tube was inserted, heat applied to the abdomen and enemata were given, but without relief There had been only one small bowel evacuation since operation, which was obtained by enema on the third postoperative day On the seventh postoperative day a scout roentgenogram showed distended coils of small and large intestine Because of the persistence of colic and progressive distention, he was put into a 95 per cent oxygen tent for 21 hours with the two one-half hour rest periods out of the tent for feeding The following observations were made during the oxygen inhalation period

TABLE I

ABDOMINAL GIRTH IN CENTIMETERS AT VARIOUS LEVELS

	Xiphoid	Umbilicus	Midway from Umbilicus to Pubis	Remarks
11 00 A M	66 cm	65 5 cm	68 cm	Put into 95% oxygen tent
3 30 P M	66 cm	65 cm	67 5 cm	Out of tent for one-half hour
7 30 P M	65 cm	64 5 cm	67 cm	Passed moderate amount of flatus and small amount of feces Out of tent one-half hour Abdomen softer
8 00 A M	62 5 cm	62 cm	64 cm	Spontaneous and adequate bowel movement Abdomen soft and collapsed

All pain and vomiting ceased, the abdomen remained soft, he passed gas freely and had normal evacuations thereafter

* This has since been modified by Schwab,[6] and more recently by Burgess [6] Both modifications have the considerable advantage of dispensing with the motor unit for

COMMENT.—The vomiting, colic, distention and failure to have bowel evacuations suggested mechanical obstruction. On the 7th postoperative day 95 per cent oxygen was administered as a final measure before resorting to enterostomy. The prompt and permanent relief of all symptoms, associated with the effective deflation accomplished, after all other measures were unavailing, lend clinical support to the experimental observation that 95 per cent oxygen is an effective agent for decompressing the intestine distended with gas.

The smooth convalescence after the oxygen inhalations indicates that we were not dealing with established mechanical obstruction. Presumably the oxygen inhalations decreased the intraluminal tension of the overstretched intestine sufficiently to allow the intestinal muscle to recover enough tone to effect an adequate evacuation.

That deflation of the bowel can be accomplished even in the presence of an organic obstruction is demonstrated by the following two cases.

Case 2.—*Obstructing Carcinoma of the Sigmoid.*—A female, age 75, was referred to the hospital for complete procidentia. She gave a history of lower abdominal colicky pain of four weeks' duration with increasing constipation and anorexia. For four days preceding entry there had been no bowel evacuation in spite of enemata and purgatives. Vomiting occurred once. Examination showed an emaciated, dehydrated elderly lady, complaining of occasional lower abdominal pain. There were râles and suppressed breath sounds at the lung bases, arteriosclerosis, and a blood pressure of 165/95. The abdomen was generally tender and markedly distended, particularly in the lower half. There was moderate audible, but no visible, peristalsis. A soap suds enema resulted in only a little flatus.

Because of her age and precarious condition, she was placed in a 95 per cent oxygen tent preliminary to performing cecostomy. She was kept in the tent for a total of 34¾

TABLE II

ABDOMINAL GIRTH IN CENTIMETERS AT VARIOUS LEVELS

	Xiphoid	Umbilicus	Midway from Umbilicus to Pubis	Remarks
5 00 P M	78 cm	82 cm	81 cm	95% oxygen started
12 30 A M	74 cm	78 cm	79 cm	Abdomen much softer. Passed a little flatus. Out of tent for one-half hour
8 00 A M	72 cm	77 5 cm	78 cm	Oil enema with gas and fecal returns
9 00 A M				Out of tent
9 45 A M	72 cm	77 5 cm	78 cm	Back in tent
12 00 NOON				Out of tent for one-half hour
6 00 P M	73 5 cm	78 5 cm	81 cm	
8 00 P M	72 cm	76 5 cm	77 5 cm	

circulating the air. Schwab's apparatus utilizes a face mask instead of a hood. This makes it impractical for administration of oxygen over long periods of time but answers the purpose for the treatment of postencephalographic symptoms. The new Burgess tent is an excellent substitute for our original apparatus, but lacks the valuable feature of a washout valve which greatly shortens the time necessary to attain the desired concentration of oxygen.

hours, with occasional interruptions for rest and to avoid the possible toxic effects of continuous, prolonged administration of 95 per cent oxygen Within seven and one-half hours after starting oxygen there was a marked decrease in abdominal girth After 15 hours the abdomen was obviously less prominent and the colicky pain had vanished Enemata were then moderately successful, especially for flatus Although the maximum decrease in girth was obtained at the end of 34¾ hours, the bulk of the effect was secured after the first 15 hours of oxygen administration

At the conclusion of the experiment the patient was entirely comfortable and seemed, clinically, so much improved that the apparent need for decompression at the time of admission was obviated and a more leisurely and adequate preoperative study and preparation were made possible Enemata continued to be effective On the fourth day after entry, a barium enema showed obstruction in the sigmoid, following which cecostomy was performed for obstructing scirrhous carcinoma of the sigmoid

COMMENT—This case is a clear demonstration of the efficacy of 95 per cent oxygen inhalations to deflate a bowel distended with gas The decrease in abdominal girth was considerable before any substantial amount of flatus was expelled, indicating that the result was effected largely by the absorption of nitrogen from the bowel into the blood

Case 3—*Perforated Gangrenous Appendicitis Peritonitis Postoperative Mechanical Ileus*—A male, age 42, following excision of a gangrenous appendix and drainage of the accompanying peritonitis, became distended in spite of passing small amounts of flatus during the first three postoperative days Eserine sulphate, heat to the abdomen and repeated enemata failed to prevent increasing distention An intragastric tube discharged large amounts of green fluid and some gas On the fourth postoperative day the inhalation of 95 per cent oxygen was started and continued for 18 hours with interruptions, totaling one and one-half hours During this period of exposure to oxygen, no gas was passed by rectum The following table shows the course of the abdominal distention

TABLE III

ABDOMINAL GIRTH IN CENTIMETERS AT VARIOUS LEVELS

	Costal Margin	Umbilicus	Midway from Umbilicus to Pubis	Remarks
4 20 P M	90 5 cm	89 5 cm	89 8 cm	Oxygen started Abdomen very tense
9 00 P M	91 5 cm	89 cm	92 cm	
12 00 P M	90 cm	87 cm	94 cm	
1 00 A M	91 cm	87 cm	91 5 cm	Abdomen softer
2 30 A M	91 cm	88 cm	91 5 cm	
6 00 A M	90 cm	86 cm	88 5 cm	Abdomen softer Patient more comfortable
9 00 A M	88 cm	85 cm	88 5 cm	
10 30 A M	88 5 cm	85 5 cm	88 5 cm	

The final measurements show a maximum reduction in girth at the umbilicus of 4 cm, but the actual decrease in distention is not accurately reflected in the figures The abdomen during the first eight hours was very tense and although the measurements at 1 A M show no obvious reduction, the abdomen had become quite soft and the patient more comfortable At the close of the period of oxygen inhalation, enterostomy was performed for acute intestinal obstruction The small intestine was edematous *but not distended with gas* Large amounts of free fluid in the peritoneal cavity accounted in part for the degree of distention originally presented Following operation all symptoms rapidly subsided and an uncomplicated convalescence ensued

COMMENT—During the period of exposure to oxygen no intestinal contents escaped by rectum, while some ten ounces of fluid and little or no gas were recovered from the stomach tube The decompression is, therefore, attributable to absorption of at least part of the distending gases by the use of the oxygen tent

The resulting fall in intra-luminal tension may have released the intestinal circulation above the point of obstruction sufficiently to facilitate partial absorption of the accumulated fluids as well Although we have no direct clinical evidence for this assertion, the experimental data at hand are adequate [2] To a large extent, therefore, the 95 per cent oxygen tent differs from an enterostomy tube only in that the rate of decompression is slower

We do not wish to imply from the experience with the cases detailed so far that the 95 per cent oxygen tent should be utilized as a routine preoperative measure in all instances of mechanical ileus But it is perhaps not too bold to suggest that by its use an enterostomy may be obviated altogether *in mechanical obstruction of a transitory nature* The evanescent character of the obstruction in many cases of generalized or localized peritonitis, in which release of the intra-intestinal tension by enterostomy is frequently all that is necessary, is familiar enough It is precisely in this sort of situation that the oxygen method may provide a valuable substitute or at least serve as a palliative during the period of indecision as to the mechanical or functional nature of the distention By way of illustration we cite the following two cases

Case 4—*Perforating Appendicitis with Peritonitis*—A male, age 3, had complained, six days previous to admission, of peri-umbilical pain and was given castor oil Pain and vomiting persisted until entry Physical examination showed a toxic, dehydrated, cyanotic child with generalized abdominal spasm and distention A gangrenous appendix was removed and an extensive pelvic peritonitis drained There was steady improvement with gradual decline in temperature and pulse rate until the sixth postoperative day, when marked distention recurred together with fever and tachycardia A bulging mass presented in Douglas' pouch No gas could be passed by rectum with the aid of the usual measures After eight hours in the 95 per cent oxygen tent he suddenly passed a large amount of flatus and had a copious bowel evacuation, with immediate softening of the abdomen and a reduction of 6 cm in abdominal girth Steady improvement followed and the pelvic mass resolved spontaneously

COMMENT—The point of view that the deflation secured was not necessarily a result of the oxygen inhalations cannot be controverted, but it loses plausibility in view of the fact that in practically all cases in which the method has been tried, the same result has been uniformly obtained

Case 5—*Bilateral Tubo-Ovarian Abscesses, Pelvic Peritonitis, Bilateral Bronchopneumonia*—A female, colored, age 39, entered the hospital with a chief complaint of abdominal pain and swelling Her past history was unimportant except that her first two children had died in infancy and her third pregnancy terminated in a miscarriage Two weeks before admission she contracted a cold, which was accompanied by a dry, hacking cough Shortly thereafter she had severe epigastric pain which later shifted to the lower abdomen The abdomen became swollen and breathing increasingly difficult Anorexia, constipation and dysuria followed and persisted for the week preceding

entry Although she took fluids during the 48 hours previous to admission, she vomited several times and passed no gas or feces Physical examination showed an acutely ill, obese Negro woman, markedly dyspneic, with evidence of bilateral bronchopneumonia and severe distention of the abdomen, which was rigid and tympanitic throughout Both lower quadrants were tender Pelvic examination showed diffuse tenderness and a profuse vaginal discharge The white blood count was 23,000 The temperature, pulse and respiration were elevated

The clinical picture of bronchopneumonia, peritonitis and distention, due either to a functional or mechanical ileus, was rather desperate Immediate celiotomy seemed to involve too grave a risk An enema yielded no flatus or fecal results An intragastric tube was introduced and fluids given parenterally She was put into a 95 per cent oxygen helmet for the relief of the distention as well as for the respiratory distress Table IV summarizes the results

TABLE IV

ABDOMINAL GIRTH IN CENTIMETERS AT VARIOUS LEVELS

	Costal Margins	Umbilicus	Midway from Umbilicus to Pubis	Remarks
12 00 P M	100 cm	105 cm	107 cm	Oxygen started
8 00 A M	105 cm	105 cm	106 cm	Removed from tent for two hours
6 00 P M	103 cm	106 cm	108 cm	Removed from tent for one and one-half hours
7 00 A M	99 cm	102 cm	104 cm	*Passed large amount of flatus for first time in 96 hours* Abdomen quite soft Patient much more comfortable

Following the period of oxygen therapy, operative exploration of the pelvis disclosed bilateral, acute and chronic tubo-ovarian abscesses with multiple fresh and old adhesions to surrounding structures Convalescence was marked by a productive cough, but there was rapid decline of the fever and tachycardia, the dyspnea abated, vomiting stopped, fluids and food were taken freely and gas and feces were passed without difficulty Distention did not recur

COMMENT —Although measurements of abdominal girth show a final decrease of 3 cm at the umbilicus after a total of 27½ hours of exposure to 95 per cent oxygen, there was a noteworthy increase in girth at various levels during the first 18 hours This seems to contradict our belief that oxygen was beneficial, at least for that period However, as already suggested in connection with a similar experience in Case 3, the measurements of girth, when the abdomen is tense, do not accurately reflect the actual degree of intestinal distention As the restricting effect of a tight musculature gives way, the viscera displaced upward into the thoracic cage and downward into the pelvis recede to their more usual positions and the compressed intestinal coils expand, so that for a time at least during the period of effective oxygen therapy the abdominal girth may actually increase

DISCUSSION —We offer the foregoing data as further support for the adoption of the 95 per cent oxygen tent method for the treatment of intractable gaseous distention of the intestine It is not possible to predict the percentage of successes or failures involved by the use of this method with-

out a much more extensive experience The consistently satisfactory results secured in the patients referred to in the previous report,[4] as well as those cited in the present communication, lead us to believe that a high average of successes can be obtained if the proper technic is adhered to

The fear of toxic effects from prolonged periods of breathing pure oxygen, reported by Binger[7] and a number of other investigators, does not constitute a valid objection to the method for several reasons (1) The nursing requirements of patients make interruptions in administration of oxygen necessary Such interruptions, averaging one-half hour in every four to eight hours,* constitute a sufficient factor of safety, as is amply demonstrated in experimental studies[8] and in our experience with patients There has not been a single instance in which the faintest suggestion of oxygen poisoning appeared We have given 95 per cent oxygen intermittently for as long as 35 hours, but much shorter periods will ordinarily suffice for the desired result (2) Should future experience fail to sustain our belief that the method is without danger, the substitution of Barach's oxygen-helium mixture,[9] which is likewise a respirable gas containing no nitrogen, would obviate this objection

The simplest types of intractable distention for which the method may be utilized are the postoperative, functional types and those associated with pneumonia or cardiac disease In addition, the distention of peritonitis is a particularly appropriate type for its application Brown[10] aptly points out that the disturbed function of the gastro-intestinal tract in peritonitis may be as inimical to recovery as the peritonitis itself If overdistention can be avoided or minimized by an agent which is more directly effective than those in current use, we may be in a position to treat peritonitis with more success than heretofore

If the distention is due to established mechanical obstruction, there is no choice but to perform an enterostomy Aside from relieving the excessive tension in the blocked loop by enterostomy, operation provides the only certain method of determining the nature of the obstruction The possible presence of strangulation makes immediate surgery obligatory regardless of the surgical risk When, however, there is good reason to believe that strangulation is not present, the element of surgical risk may justify withholding immediate operation if a useful alternative exists which will, at least temporarily, efficiently decompress the bowel In these circumstances the inhalation of 95 per cent oxygen should find its place

We have used the intragastric catheter routinely during the administration of oxygen in order to prevent the entrance of air or oxygen into the duodenum In no instance was it possible to attribute any substantial portion of the deflation accomplished to the amount of gas discharged through the catheter

The suction method of Wangensteen has its own important indications, but it is doubtful if it can be confidently relied upon in low obstructions to

* Periods of rest out of the tent, unless unavoidable, should ordinarily not exceed one-half hour because the longer the patient breathes atmospheric air the more nitrogen enters the blood from the lung and the longer is the subsequent interval in the tent in order to desaturate the blood of its nitrogen

deflate the bowel just above the block, which is the part in most urgent need of it Nor can a suction tube answer the needs of a case in which more than one level of obstruction exists, such as may occur in peritonitis In this instance, as in any closed loop obstruction, the commonest example of which is obstruction of the colon, the choice rests between an enterostomy or 95 per cent oxygen administered through a helmet To the extent to which a suction tube, like an enterostomy tube, removes fluid directly, it is probably superior to the oxygen method, which can only do so indirectly by improving the absorptive capacity of the bowel after partial deflation A combination of both methods applied simultaneously should provide the maximum benefit which each has to offer

In long standing obstruction the bowel musculature is occasionally so paralyzed from overstretching that enterostomy fails to result in prompt evacuation Cheever[11] and others have therefore, been led to eviscerate the gut and express the retained fluids and gas at the time of enterostomy There are those who feel that this is a heroic procedure fraught with danger In the controversy concerning the relative merits of rapid versus slow decompression, a middle ground may be taken by performing the enterostomy and supplementing it with the administration of 95 per cent oxygen If the enterostomy fails to function, the oxygen tent will at once initiate gradual deflation and permit a more rapid recovery of muscle tone than might occur spontaneously If the enterostomy functions too well, according to those who fear the effects of too sudden decompression, the tube can be clamped, gradual deflation accomplished more gradually by the oxygen tent and the tube opened at a less critical period thereafter

SPONTANEOUS PNEUMATHORAX MEDIASTINAL EMPHYSEMA

Expansion of the lung after spontaneous pneumathorax can occur only after the point of rupture is healed Until then withdrawal of air by needle and syringe from the pleural cavity is the simplest and most effective way in which to relieve the pressure effects of pneumathorax

In a previous paper[3] we stated that "in the case of valvular pneumothorax or mediastinal emphysema, for which the method (95 per cent oxygen inhalation) might be utilized, we encounter a different situation than in instances of completely closed spaces containing air, in that the volume of gas entering the pleural or mediastinal space is not a limited quantity, but continues to increase as long as the point of entrance of air remains open Substituting pure oxygen for air as the respiratory gas would result in the absorption of the nitrogen, but its immediate replacement by the entrance of oxygen through the defect would offer no advantage in counteracting the pressure effects of the gas, unless the rate of entrance of the oxygen through the defect were no greater than its rate of absorption by the tissues ' The following cases are illustrations in point

Case 6—*Ruptured Emphysematous Bleb? Valvular Pneumathorax*—A male, age 56, with a history of chronic productive cough for 30 years, was suddenly seized with

severe dyspnea while climbing stairs, five months before admission He remained dyspneic and bedridden seven weeks Thereafter he was able to be up, but walking a block or two caused breathlessness He entered the hospital with the complaint of dyspnea on exertion Physical examination showed a dyspneic and orthopneic patient with a right-sided pneumathorax This was confirmed roentgenographically, which showed collapse of the entire right lung The remainder of the history and physical examination was negative or irrelevant The cause of the pneumathorax was considered to be due either to an acid fast bacillus infection, for which there was insufficient evidence, or rupture of an emphysematous bleb

The special feature of the case was the persistence of the pneumathorax for five months Failure of the lung to reexpand after such a long interval implies that the original point of rupture had not healed If this be true, the oxygen in the air of the pleural space should approximate the oxygen content of alveolar air, which is 16 per cent A gas analysis of a sample from the first 500 cc of air withdrawn gave the following results Oxygen 3 2 per cent, carbon dioxide 8 8 per cent, nitrogen 88 per cent—proportions more nearly those ordinarily found in tissue spaces or what might be expected in a closed pneumathorax But a closed pneumathorax of this duration should have allowed sufficient readjustment of cardiorespiratory mechanics to banish the dyspnea Furthermore, even if the collapsed lung had become "hepatized" or resisted expansion because of a viscid intrabronchial secretion, collapse of the chest wall, elevation of the diaphragm or ipsolateral displacement of the mediastinum should have occurred, but none of these was present according to the roentgenographic evidence The apparent contradiction of facts could be reconciled only on the assumption that a leak, probably of a valvular type, must still be present but too slow to reflect the higher oxygen content of alveolar air

Roentgenographic examination immediately after the removal of the first 500 cc of air, and on the next day of 900 cc, failed to show any expansion of the lung The patient, nevertheless, experienced subjective relief from dyspnea In these circumstances further withdrawal of air seemed worth trying, but the immediate withdrawal of the air, or even a large fraction, might tear and enlarge the original hole causing the pneumathorax Precaution to avoid this hazard suggested the use of 95 per cent oxygen to facilitate a gradual and uniformly distributed expansion of the lung Accordingly, the patient was given seven hours of continuous inhalations of 95 per cent oxygen, but only a very slight expansion of the middle lobe resulted The insignificant effect on the volume of air in the pleural space produced by seven hours of oxygen therapy was not surprising, for although such a period of exposure to oxygen should give a measurable result in the intestine or in the subarachnoid space, the pleural cavity, like the stomach, offers a comparatively poor surface area per unit volume of nitrogen for absorption *

The oxygen content of the intrapleural air after the seven hour oxygen period rose from 3 2 to 4 3 per cent Such an increase in oxygen percentage is consistent with a very slow leak, but it might also be consistent with a rise in oxygen saturation of the tissues as a result of breathing pure oxygen for seven hours Lacking clinical data on this aspect of the problem of gas diffusion, we proceeded as follows With the patient breathing atmospheric air, 2,000 cc of air were withdrawn by needle and syringe from the pleural cavity Gas samples were taken for analysis during withdrawal of the 2,000 cc of air, at one-half hour, one hour, and two hours afterward, with resulting oxygen concentrations of 3 3, 3 6, 6 78, and 7 5 per cent, respectively We should now have been convinced of the presence of a leak had not a hissing sound been heard near the occluded needle left in place during these observations That the leak, if present, was in fact a

* In a previous paper[2] calculation of the relative surface areas of the stomach and small intestine showed that the latter has an absorbing surface ten times that of the stomach Consequently a seven hour effect from 95 per cent oxygen on gases in the intestine would theoretically require 70 hours for the same result on gases in the stomach In this respect the pleural cavity is analogous to the stomach

slow one was suggested by a roentgenogram which showed, for the first time, a substantial expansion of the right upper lobe

Ninety-five per cent oxygen was then administered for 17 hours, with a further, though negligible, increase in the expansion of the upper lobe The expansion persisted for the following 24 hours and the relief of the dyspnea, at rest, was almost complete It was decided to attempt a gradual and evenly distributed additional inflation of the lung by withdrawing 2,000 cc of the residual air in increments of 500 cc, and simultaneously replacing it with equal increments of pure oxygen Complete expansion of the upper lobe and partial expansion of the middle lobe resulted, and the vital capacity increased from 1 1 to 1 8 liters Since the patient was free of dyspnea and was for the first time able to be up and about without respiratory discomfort, nothing further was done Should the last procedure have failed to improve the symptoms, we had intended repeating it after first desaturating the blood of its nitrogen by administration of 95 per cent oxygen for several hours The patient remained well with moderate activity out of bed for the next five days, but roentgenographic examination on the day of discharge showed partial recollapse of the right upper lobe He remained active and free of discomfort for the next four weeks only to relapse to a state of dyspnea on mild exertion The evidence is therefore clear that this is a case of valvular pneumathorax with a very slow leak

COMMENT —The details of this case demonstrate the correctness of the argument presented in the introductory paragraph of this section We were only partially successful in expanding this patient's lung because the leak was still present after five months The slowness of the leak made possible whatever temporary improvement we did secure The oxygen inhalations did not, and could not, be expected to produce a significant expansion of the lung

In another case of recent spontaneous pneumathorax, oxygen inhalations proved quite useless because the leak was far too great Within 20 minutes after applying the oxygen helmet, a gas sample from the pleural space showed 88 per cent oxygen, indicating the futility of attempting reexpansion of the lung by oxygen For the same reason the method proved futile in the following case of mediastinal emphysema

Case 7 —*Mediastinal Emphysema, Bilateral Pneumathorax Subcutaneous Emphysema, Foreign Body in Bronchus Ruptured Bronchus*—A female, age 3, aspirated a nut into her trachea the night before admission At entry into the hospital she had wheezing respirations, and a roentgenogram showed hyperventilation of the left lung Bronchoscopy for extraction of the nut from the left primary bronchus was followed by normal respiratory function of the left lung, but several hours later subcutaneous emphysema of the head and neck, and shortly thereafter of the entire body, appeared The temperature rose to 102° F, the respirations varied from 40 to 60 per minute and the pulse rose to 160 She became cyanotic and was placed in a 95 per cent oxygen tent with prompt relief of the cyanosis but not of the dyspnea The following morning the temperature was 105° F and roentgenographic examination showed extensive, bilateral pneumathorax The subcutaneous emphysema involved the whole body and was extremely tense Immediate aspiration of the air from the left pleural space resulted in prompt relief of the dyspnea Another roentgenogram showed considerable reexpansion of both lungs The subcutaneous tissues, which up to this moment had remained very tense, immediately and dramatically softened It was obvious that the leakage of air from the presumably ruptured bronchus was far too great to make the oxygen inhalations of any value except for the relief of the cyanosis Excellent oxygenation of the tissues was evident, so that the tent was continued in use To prevent reaccumulation of air in the pleural spaces a trocar was inserted into the right pleural cavity, through an inter-

costal space in the axillary line, and connected to a rubber tube, the end of which dipped slightly beneath the level of a column of water Within 12 hours the patient's temperature fell to 100° F and the pulse to 130 Careful attention to the one-way water valve resulted in satisfactory clinical improvement for 24 hours, following which the trocar became obstructed and the temperature again rose to 105° F Readjustment of the trocar was followed by an immediate fall in temperature to 100° F, the pulse to 120, and the respirations to 30 She seemed to be doing extremely well thereafter taking food, talking, *etc* The temperature, pulse and respirations did not rise markedly She was taken out of the oxygen tent at intervals with no resulting discomfort On the third night the child became cyanotic while out of the tent and died suddenly

COMMENT —This is an instance of mediastinal emphysema so fulminating in character as to preclude any possibility of help by 95 per cent oxygen There was no effect whatever on the pneumathorax or the subcutaneous emphysema until a vent for the steadily accumulating air was made The oxygen tent served only to oxygenate the blood more effectively than might have been possible in the ordinary oxygen tent It had the additional advantage over the latter, as already described in a previous paper, that by enclosing the head and neck only, the chest was accessible for nursing and special procedures such as thoracotomy without depriving the cyanotic patient of a constant supply of oxygen

The striking fall in temperature, after release of the incarcerated air in the chest and subcutaneous tissues, suggests that the fever may have been caused by inability to dissipate heat (1) via the expired air, owing to the pneumathorax, and (2) via the skin, owing possibly to interference with the circulation of the skin and subcutaneous tissues by the high tension of the gases in the interstitial spaces

POSTENCEPHALOGRAPHIC SYMPTOMS

Following encephalography most patients experience a variable degree of headache, nausea and general indisposition lasting from 24 to 72 hours The disability may be severe and even prostrating Such patients form ideal subjects for the clinical evaluation of the theoretic principles underlying the mechanism of the action of 95 per cent oxygen for the absorption of air from tissue spaces The air consists of a fixed volume distributed over a surface area (the cortical subarachnoid space and ventricles) which is relatively large for the amount of air requiring disposal, as compared with such conditions as pneumathorax or even gaseous distention of the intestine

Following is the first instance in which 95 per cent oxygen was tried for postencephalographic headache

Case 8 —*Epilepsy Postencephalographic Headache* —An epileptic girl, age 26, had an air injection into the spinal subarachnoid space for encephalography at 2 00 P M May 24, 1935 Sodium amytal effected sleep for three hours, then she awoke with severe headache which persisted in spite of opiates At 11 45 A M the following day, while still suffering with violent headache, she was placed in a 95 per cent oxygen helmet Thirty minutes later she felt much relieved and two hours later the headache had completely disappeared

Comment.—After this experience Schwab, Fine and Minter[5] studied the results of oxygen therapy in 37 cases. Although not all patients were uniformly and completely relieved of the distressing symptoms caused by the air injection, the beneficial effects were sufficiently striking to justify adoption of the procedure as a routine therapeutic measure.

A maximum of three hours of exposure to 95 per cent oxygen inhalations suffices for the absorption of the bulk of the injected air, as shown by roentgenograms before and after the administration of the oxygen. There is a simultaneous disappearance of headache and nausea. The prophylactic use of 95 per cent oxygen results in either complete or partial avoidance of these symptoms. A slight headache and mild nausea may persist in some instances, but, as a rule, the patient is fit and able to be up within 24 hours, which is distinctly shorter than is the case for patients who are not given oxygen.

This procedure has been considered unnecessary by those utilizing oxygen instead of air for encephalography. It is unfortunately not always possible to avoid the postencephalographic syndrome by the use of oxygen, because nitrogen enters the subarachnoid space and the ventricles from the blood during the time required for the absorption of the oxygen.[3] Schwab *et al*[5] have demonstrated the value of breathing oxygen even when oxygen is employed as the visualizing medium. It is possible, however, that the extremely rapid diffusibility of the anesthetic gases recently advocated by Arnd,[12] or of the oxygen-helium mixture of Barach, may supplant pure oxygen or atmospheric air as the visualizing agent. To the extent to which these newer agents may succeed in avoiding the postencephalographic symptoms, inhalation of 95 per cent oxygen will be rendered unnecessary.

AIR EMBOLISM

Death from air embolism is due either to obstruction of the pulmonary capillaries from air entering the great veins in the neck or chest, or to air entering the coronary or cerebral arteries from pulmonary veins, severed or torn, during intrathoracic operations. To avoid such a catastrophe the only available prophylactic measure is the routine use of the Trendelenburg position suggested by Lilienthal.[13] On theoretic grounds an approach to the problem might be made by preparing patients, in whom the danger of air embolus exists, so that the nitrogen fraction of the air bubbles shall diffuse out of the blood with the maximum possible speed. This can be done by desaturating the blood of its nitrogen content by the use of a general anesthetic containing no nitrogen, such as cyclopropane and pure oxygen, or by the inhalation of pure oxygen if the operation is performed under local anesthesia. We have, however, failed to prolong the life of cats, who were given a minimal lethal dose of intravenous air, by the preliminary administration of pure oxygen for one hour. Whether oxygen will avail in air embolus into the cerebral or coronary arteries is the subject of a current experimental investigation. We have had no clinical experience with the use of oxygen for this purpose.

CONCLUSIONS

(1) The inhalation of 95 per cent oxygen, according to a technic previously described, provides an effective method for deflation of the distended intestine when other nonoperative measures fail Ninety-five per cent oxygen is a valuable agent whether the distention is of functional or mechanical origin In mechanical ileus it may be used to advantage before or after enterostomy is performed

(2) Ninety-five per cent oxygen is of little or no value for the treatment of valvular pneumathorax or mediastinal emphysema so long as the size of the point of rupture is of any consequence

(3) Ninety-five per cent oxygen inhalations prevent or relieve the symptoms following encephalography

(4) None of the patients who breathed 95 per cent oxygen, for the length of time necessary to obtain therapeutic effects, showed any signs or symptoms of oxygen poisoning Toxicity was avoided by interrupting the administration of the gas every four to eight hours for one-half hour or longer

5) The length of time necessary to obtain therapeutic benefit from the administration of 95 per cent oxygen cannot be predicted in any given case It will vary in accordance with the volume of air to be absorbed and the relative extent of the surface area available for absorption

BIBLIOGRAPHY

[1] Shaw, L A Personal Communication
[2] Fine, J, Sears, J B, and Banks, B M The Effect of Oxygen Inhalation on Gaseous Distention of the Stomach and Small Intestine Am J of Dig Dis and Nutrition, 361, 1935
[3] Fine, J, Frehling, S, and Starr, A Experimental Observations on the Effect of Ninety-five Per Cent Oxygen on the Absorption of Air from the Body Tissues J of Thor Surg, 4, 635, 1935
[4] Fine, J, Banks, B M, Sears, J B, and Hermanson, L The Treatment of Gaseous Distention of the Intestine by the Inhalation of Ninety-five Per cent Oxygen Annals of Surgery, 103, 375, 1936
[5] Schwab, R S, Fine, J, and Mixter, W J The Reduction of Post-Encephalographic Symptoms by the Inhalation of Ninety-five Per Cent Oxygen Arch Neur and Psychiatry, 37, 1271, 1937
[6] Burgess, A M Oxygen Therapy A Modification of the Box Method Giving Ninety-five Per Cent Oxygen New England J Med In press
[7] Binger, C A L, Faulkner, J M, and Moore, R L Oxygen Poisoning in Mammals J Exper Med, 45, 849, 1927
[8] Savres, R R Quoted by Evans, J H, and Dushordwe, C J Further Observations on Oxygen Therapy in the Treatment of Pneumonia Anesth and Anal, 2, 193, 1932
[9] Barach, A L Use of Helium in the Treatment of Asthma and Obstructive Lesions of the Larynx and Trachea Am Int Med, 9, 739, 1935
[10] Brown, H P, Jr Peristalsis and Peritonitis Annals of Surgery, 100, 167, 1934
[11] Cheever, D Operative Evacuation of the Small Intestine in Paralytic Stasis New England J Med, 207, 1125, 1932
[12] Aird, R B Experimental Encephalography with Anesthetic Cases Arch Surg, 32, 193, 1936
[13] Lilienthal, H Thoracic Surgery 2 vols Saunders, 1925

RESULTS IN THE OPERATIVE TREATMENT OF MAJOR TRIGEMINAL NEURALGIA

FRANCIS C GRANT, M D
PHILADELPHIA, PA

TRIGEMINAL neuralgia does not endanger life Intermittent attacks of severe paroxysmal pain in cheek, lip or tongue, however, interfere with eating or drinking and result in loss of weight and strength Although sufferers from this condition have hoped that death might bring relief from the pain, and suicide from this cause is not unknown, nevertheless, many persons have enjoyed relative comfort for many years in spite of it The abrupt remissions of the pain, so characteristic of the seizures, always lead to the hope that they will not recur

Relief of the pain by surgical intervention becomes, therefore, a question of expediency The mortality of such an operation must be carefully considered Following surgery, can the patient be assured of complete relief of pain? What are the possible sequelae of an operation?

In this series the transtemporal approach to the sensory root of the trigeminal nerve has been employed The late Dr Charles H Frazier developed and perfected the practical details of this technic and operated upon the majority of the cases herein recorded Since he saw no added advantage in the suboccipital approach to the sensory root, the records from this Clinic do not contain a sufficient number of cases operated upon by that technic to permit an opinion relative to comparative results

The problems to be considered in the surgical treatment of major trigeminal neuralgia are (1) The operative mortality, (2) the type of operation to be performed, whether the sensory root should be completely or partially sectioned and the motor root preserved or cut, (3) the percentage of postoperative complications, such as keratitis, facial paralysis or diplopia due to injury of the adjacent third or sixth cranial nerves, and (4) the percentage of complete relief of pain without the appearance of annoying paresthesias

(1) *Mortality*—In this series the transtemporal, or approach to the sensory root through the middle fossa, was employed in 949 operations upon 925 patients with 13 deaths, an operative mortality of 1 36 per cent In the first 100 cases in which the sensory root was cut the mortality was 4 per cent In dividing the whole series into groups of 100, in two of these groups no fatalities occurred, in three the mortality was 1 per cent, and in two, 2 per cent No fatalities occurred in 286 consecutive cases In the latest group from 900 to 949, no deaths followed operation

This operative mortality has been strictly considered Any patient dying in the hospital, no matter how long after operation, and regardless of the

cause of death, has been included Seven cases died of cerebral embolism or apoplexy, three within 24 hours of operation, one on the fifth, one on the sixth, one on the ninth, and one on the fourteenth day postoperatively Three patients died of postoperative hemorrhage and clot, two from meningitis and one from pneumonia (Table I)

TABLE I

PERCENTAGE OF MORTALITY

949 Operations	925 Patients
13 Deaths	1 36% Mortality

CAUSES OF DEATH

Cerebral embolism	7
Hemorrhage	3
Meningitis	2
Pneumonia	1

That more than half of the operative mortalities were the result of cerebral vascular accidents is doubtless due to the fact that 83 per cent of these patients were 50 or over at the time of operation As we have stated, major trigeminal neuralgia is a condition appearing in the later years of life However, an operative mortality of 1 36 per cent is evidence that even in elderly people operative relief for the pain should not be refused unless really serious contraindications exist

(2) *Type of Operation to Be Performed*—Whether the sensory root should be completely or incompletely severed and the motor root preserved or cut can best be determined when the operative complications are considered If pain is not referred to the first division, a subtotal avulsion, preserving part at least of the fibers to the ophthalmic branch, is indicated Frequently cases are encountered where the trigger zone exists in the second or third division of the sensory area but not in the first To be sure, irritation of this trigger zone causes pain over the eye, but touching the eyebrow or forehead is not followed by pain in the maxillary or mandibular branches Under such circumstances a subtotal sensory root section will relieve the pain, although anesthesia will not be complete in the skin areas supplied by the ophthalmic branch The corneal reflex will be preserved

(3) *Incidence of Postoperative Complications*—The two most feared sequlae are keratitis in the ipsilateral eye and facial paralysis Injury to the adjacent third or sixth nerve can occur, although more likely to follow complete or incomplete avulsion of the gasserian ganglion than section of the sensory root The third and sixth nerves were injured on 24 occasions, or 2 5 per cent In ten of these cases a complete avulsion of the ganglion was effected so that if the sensory root is attacked behind the ganglion, the percentage of third and sixth nerve involvement falls to 1 1 per cent

A partial facial paralysis resulted in 33 cases, or 3 4 per cent The recording of partial facial paralysis has been noted very carefully Any facial paralysis, no matter how slight, has been noted All of these cases recovered

completely within a year, 19 of them within three months of operation Six cases of complete facial paralysis, without recovery, have been observed, or 0 65 per cent

Two causes for facial paralysis following root section have been suggested [1] When avulsion of the whole root was practiced, it was believed that either the seventh nerve was damaged at the time the sensory root of the fifth was torn away or that following avulsion a hemorrhage in the pons with damage to the nucleus of the seventh nerve might have occurred We now believe that stripping the dura from the floor of the skull just in front of the ganglion damages the petrosal vein or nerve The petrosal vein runs with the facial nerve in its canal As the dura is elevated to expose the ganglion sheath the vein is torn in the facial canal and hemorrhage occurs compressing the seventh nerve in its passage through the bone The observation of Gardner and Babbitt[2] that in a large percentage of these cases of facial paralysis a hemorrhage in the middle ear with blackening of the drum-head could be noticed, supports this impression The petrosal nerve connects with the geniculate ganglion of the facial nerve Avulsion of this nerve in elevating the dura damages this ganglion and interrupts the function of the seventh nerve

Eighty-five instances of keratitis resulted from complete or incomplete section of the sensory root Fifty-nine instances occurred in 353 cases of complete root section, or 16 7 per cent In 590 cases of subtotal section of the sensory root 26 instances of keratitis were observed, or 4 4 per cent In five of these a partial facial paralysis resulted from the operation, preventing closure of the eyelids and rendering the development of keratitis almost inevitable That the keratitis following complete sensory root section is more severe than when subtotal section is performed is borne out by the fact that in the 59 instances of keratitis following complete section, in 15, closure of the eyelids was necessary to control the ulceration and in six cases enucleation of the eye was necessary because of the extensive infection In the 26 cases subsequent to subtotal section of the root, no eyes were sacrificed, and in but five was the keratitis sufficiently severe to demand suture of the eyelids These figures support Frazier's[3] contention that incomplete root section would go far toward eliminating keratitis

TABLE II

THE INCIDENCE OF KERATITIS AND RECURRENCE AFTER TOTAL AND SUBTOTAL RESECTION OF THE SENSORY ROOT

	No of Cases	Third Nerve	Sixth Nerve	Seventh Nerve (Partial)	Com plete	Keratitis	Eyes Lost	Lids Sutured	Recur rences
Complete sensory section	359	5	13	6	4	59 (2 with 7th N)	6	15	7 over 7½ yrs
Incomplete sensory section	590	3	3	27	2	26 (5 with 7th N)	0	5	44 over 4 yrs

(4) *Relief of Pain Paresthesias and Recurrence of Pain* —Complete relief of the original pain followed 942 of these 949 operations, or 99 2 per cent

In seven patients no relief followed complete or incomplete section These patients had precisely the same pain postoperatively as they had had before operation although complete facial anesthesia had been produced Obviously, major trigeminal neuralgia was not the cause of the pain Atypical or minor neuralgia was present and operation should never have been performed This error in diagnosis can be avoided by injection with alcohol of the appropriate branch of the fifth nerve before operation

TABLE III

RELATION OF PARESTHESIAS TO TYPE OF OPERATION

	Total Sensory and Motor	Total Motor Spared	Subtotal Sensory and Motor Spared	Subtotal Sensory and Motor Cut	Avulsion Ganglion	Section Second and Third Nerves
	271	67	470	107	15	19
No relief of pain	2	1	0	2	1	1
Severe paresthesia	16	1	20	3	1	0
Mild paresthesia	23	11	48	12	2	0

One hundred thirty cases complained of paresthesias, (13 8 per cent) Ninety-eight of these paresthesias were mild (10 3 per cent), of the type in which the patient was perfectly satisfied with the result of the operation and had complete relief of pain, but noticed the numbness of the face, had a sense of mild temperature disturbance, heat or cold, itching, or a sensation of formication in the anesthetic area Thirty-two (3 4 per cent), had severe paresthesias, developed a different type of pain in the anesthetic area, usually burning and dull, and were almost as uncomfortable after operation as they were before Fourteen of these patients developed this trouble within six weeks of operation, 18 within the first year postoperatively This pain was entirely unlike the former stabbing, lancinating tic pain, but was a fairly continuous burning ache deep in the anesthetic area Four of these patients were subjected to reoperation upon the sensory root without relief Fifteen had various operations directed against the sympathetic nerve supply of the face, with very indifferent results Only one was relieved who had been subjected to a carotid sympathectomy

Fifty-one cases of recurrence (5 3 per cent), of true major trigeminal pain occurred in this series, seven in 359 cases of complete sensory root ablation (2 per cent), and 44 among 590 patients in whom partial section was accomplished (7 4 per cent) Of the seven cases the recurrence appeared on six occasions in the first and once in the third division Obviously, recurrence of pain was due to the fact that the operator failed to sever completely all the fibers of the root In the 44 cases pain reappeared in the first division in 40, in the third in three and in the first and third in one In the 40 cases the fibers running to the first division were deliberately spared to preserve the corneal reflex and prevent keratitis Thirty of these cases were subsequently relieved by supra-orbital avulsion and five by reopera-

tion and complete severance of the sensory root Five were not reoperated upon The four cases having recurrence in the third or first and third divisions were cases in which the original pain occurred entirely in the second division, and in whom only the middle third of the root was severed These were relieved by reoperation and complete root section

In the seven cases of recurrence following what was thought to be complete sensory root section, the pain reappeared on an average of seven and one-half years after operation In the 44 cases of incomplete sensory root ablation the recurrence occurred on an average of four years postoperatively

In 17 patients the pain appeared on the opposite side after it had been relieved on the side on which it commenced These cases are not included as recurrences Five were relieved by bilateral operation, two by bilateral alcohol injection of the trigeminal branches involved, ten were operated upon on the side where the pain originated and the pain when it reappeared on the opposite side was checked by alcohol block An average of four years and four months elapsed between the relief of pain upon one side and its onset upon the other, the shortest period being nine months, and the longest 12 years Nine patients were seen with typical trigeminal neuralgia on both sides All had a radical operation performed on one side and in seven an alcohol block stopped the pain on the other No deaths occurred in this series

This group of patients is particularly important because it emphasizes the fact that bilateral trigeminal neuralgia can be easily and permanently relieved by bilateral operations if the indications arise The improved technic of subtotal section and preservation of the motor root preserves the integrity of the muscles of the lower jaw and greatly reduces the chances of ocular complications

The question has been raised whether any sensory fibers might be carried by the motor root If such fibers were present the preservation of this root might account for subsequent paresthesias in the anesthetic area of the face In 392 cases in this series, in which the motor root was sacrificed, disregarding for the moment whether the sensory root was completely or incompletely sectioned, there resulted 22 severe and 46 mild paresthesias, or 5 5 and 11 7 per cent respectively Among 537 cases in which the motor root was spared, again regardless of whether the sensory root was completely or partially sectioned, there were 21 severe and 50 mild paresthesias, or 3 9 and 9 3 per cent respectively Apparently preservation of the motor root does not increase the frequency of postoperative paresthesias Certainly for functional reasons every effort should be made to preserve it

Another important, but unfortunately seldom used, indication for block of the fifth nerve fibers exists besides trigeminal neuralgia [4] Malignant disease of the face, mouth or paranasal sinuses may often be a source of severe and constant pain By an alcoholic injection of the proper branch, or, if the pain be widespread, by section of the sensory root, this pain can be relieved And if this constant pain be relieved it is amazing how the morale of these patients is improved They can eat and sleep in comfort, they gain weight and

strength The insertion of radium needles or fulguration of the cancer does not distress them and they are ready and willing to undergo much more radical treatment I am sure that several patients rendered free from suffering by trigeminal block owe their final cure to the fact that an extensive and radical attack upon the malignancy was undertaken in an anesthetic area In 41 cases, sensory root section or intracranial section of the second and third divisions was performed One death occurred in this series This group of cases is not included in making up the statistics for the operative results in major trigeminal neuralgia They are mentioned simply because much unnecessary suffering can be avoided if this use of trigeminal block be kept in mind

CONCLUSIONS

A review of the operative treatment of major trigeminal neuralgia strongly reinforces the opinion that subtotal section of the sensory root with preservation of the motor root is the procedure of choice It is true that recurrence of pain can and does occur But the protection that sparing the ophthalmic fibers affords the cornea, the reduction in the number and severity of postoperative paresthesias, more than makes up for this single disadvantage If recurrence is noted, it almost always involves the first division Supra-orbital avulsion is an easy and cosmetically unobjectionable means of relief When the age and general health of the group of patients suffering from major trigeminal neuralgia is considered, an operative mortality of 1 36 per cent is extremely satisfactory Little or no reason seems to exist for a refusal to attempt to relieve the pain of even the most debilitated of these sufferers Temporary relief may first be afforded through an alcohol injection, then, when the patient has been restored to health, permanent relief can be effected by subtotal section of the sensory root

REFERENCES

[1] Dixon, S F On the Course of the Taste Fibers Edinburgh M J , 1, 395, 1897
[2] Gardner, W J , and Babbitt, J A The Occurrence of Tympanic Hemorrhage Following the Radical Operation for the Relief of Trigeminal Neuralgia Ann Otol Rhinol and Laryngol , 38, 1040, 1929
[3] Frazier, C H Subtotal Resection of Sensory Root for Relief of Major Trigeminal Neuralgia Arch Neurol and Psychiat , 13, 378, March, 1925
[4] Grant, F C Relief of Pain by Nerve Section J A M A , 92, 116, January 12, 1929

SPASMODIC TORTICOLLIS TREATED BY THE PLASTIC REDUCTION OF MOTOR FIBERS OF THE SPINAL ACCESSORY NERVE

REPORT OF TWO CASES

CLEMENT B MASSON, M D
NEW YORK N Y

DOGLIOTTI,[1] in 1934, published the results of his operative treatment on the facial nerve for spasmodic movements of the facial muscles often referred to as a facial tic It was his theory that if the facial nerve on the affected side were severed, the central portion carefully split in half, and only one-half of the central end sutured to the entire peripheral end of the nerve, harmful nerve impulses could be reduced by at least 50 per cent In so doing the *nerve-muscle-threshold would be raised and such impulses that did arise* would be enough to supply tone to the facial muscles, provide innervation for any of the former movements of expression but not enough to cause disfiguring spasmodic movements In 1935, he demonstrated that his theory was correct If this were successful in dealing with the seventh cranial nerve the question arose Would it be successful in the case of the eleventh cranial nerve in the treatment of spasmodic torticollis?

The author is well aware of the commonly used operation for torticollis, such as severing the first three anterior and posterior cervical roots together with the intradural section of one or both spinal accessory nerves This operation is quite a radical procedure and while it is successful in ridding the patient of the troublesome spasmodic movements of the head and neck, it does rob the patient of a large amount of power from head, neck and shoulder movements One patient subjected to this operation was cured of his torticollis but unable to return to his former work of pressing clothes because of the loss of trapezius power in the right shoulder It is further proposed that a complete section of the eleventh nerve on one or both sides followed by a partial resuture may not be adequate in every case of spasmodic torticollis, but should be used first since it is a less serious operation and more conservative The anatomy and operative technic are shown in Figs 1 and 2

The eleventh, or spinal accessory nerve, consists of two parts, the accessory part to the vagus and the spinal portion The former is much smaller and is distributed to the pharyngeal and superior laryngeal branches of the vagus to supply in part the azygos uvulae, levator palati muscles, and possibly some few fibers continue on to be distributed with the recurrent laryngeal nerve to supply most of the laryngeal muscles The spinal portion takes its origin from rootlets as far down as the seventh cervical segment of the cord which, in turn, come from the anterior gray substance of the cord These rootlets join and form a trunk which increases in size as it ascends between

Submitted for publication June 16, 1937

the dentate ligaments and the anterior roots of the spinal nerves This portion then enters the posterior fossa of the skull by way of the foramen magnum and leaves by way of the jugular foramen, receiving here a few filaments from the vagal accessory portion of the eleventh nerve At its exit from the jugular foramen, it passes backward, either in front or behind the internal jugular vein, and descends obliquely behind the digastric and stylohyoid muscle to the upper part of the sternocleidomastoid muscle It pierces that muscle, and passes obliquely across the posterior triangle, to terminate in

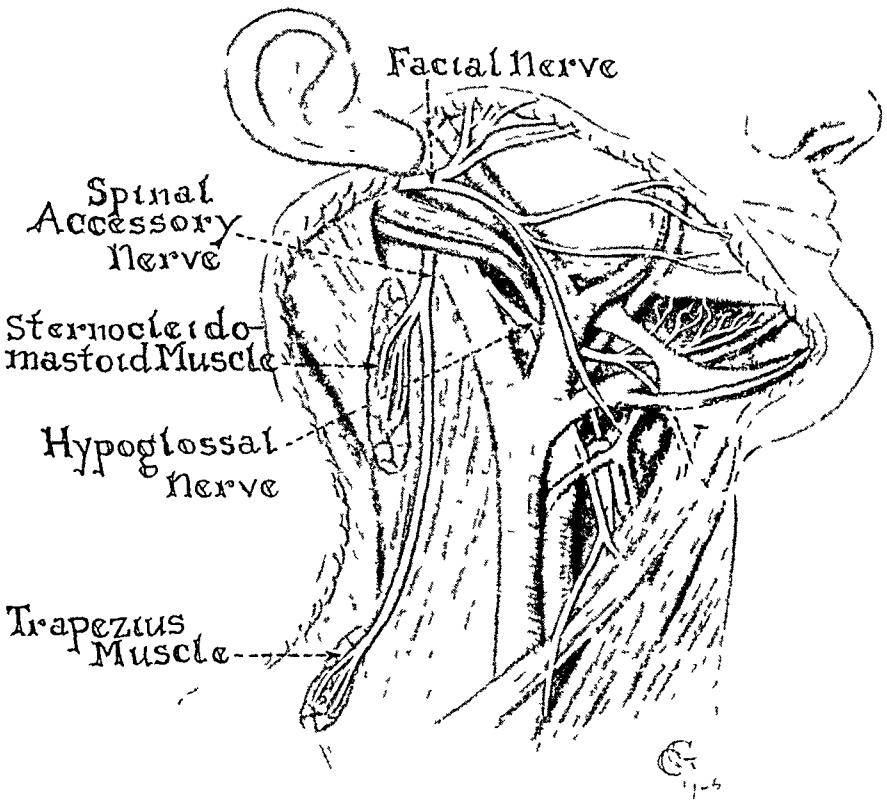


FIG 1.—Drawing illustrating the anatomic relations of the spinal accessory nerve to the other structures in the neck (After Wilbasse Surgical Treatment, 1, 887)

the deep surface of the trapezius muscle [2] The nerve is exposed and operated upon along that part of its course after leaving the lower border of the digastric muscle and before it enters the sternocleidomastoid muscle (Fig 1)

CASE REPORTS

Case 1.—St Vincent's Hospital, No 15922 A W, age 39, single, electrician, admitted October 6, 1935, operated upon October 17, 1935, and discharged, improved, October 23, 1935 Diagnosis Bilateral intermittent spastic torticollis

The disease began seven years ago and has been progressive, so that it interfered with his work, which consisted of walking along subway tracks to inspect the installation of electrical equipment There was nothing in his work that necessitated turning his head in any one direction He used stimulants moderately, and suffered no physical or mental traumata before the onset of the torticollis

In 1926, two years before the onset of symptoms of torticollis, the patient suffered a severe infection in the left nasal passage which spread to the throat and to both ears

and eyes He was ill for five weeks The type of organism was not ascertained, but if it can be substantiated that the disease has an infectious onset then this widespread infection might be considered a possible etiologic factor of his torticollis During 1928, slight spontaneous movements of the head to the left occurred daily They were painless and easily controlled but gradually, after a lapse of three or four years, the spasms became more severe, accompanied with pain in the left side of the neck, and were almost entirely out of his control A resection of the right sternocleidomastoid muscle, in 1933, did not improve his condition

Physical Examination, October 6, 1936, showed a robust man lying quietly in bed without distress or pain There were intermittent involuntary contractions of all the muscles on the left side of the neck and, to a lesser extent, the deep muscles on the right side Especially upon effort, such as sitting up, talking and walking, irregular movements of the left trapezius and sternocleidomastoid muscle and deeper groups would occur followed soon by similar muscle groups on the right side Bilateral involvement was evident with the left side affected first, and subsequently involuntary contractions occurred in muscles of the opposite side of the neck When in a spasm the occiput was directed toward the left shoulder and the chin upward and to the right There was a noticeable hypertrophy of the left sternocleidomastoid and trapezius muscles, and a very evident deformity was present on the right side as a result of a previous operation, at which the origin of the sternocleidomastoid muscle was severed No other neurologic signs were found A blood count, urinalysis and blood Kahn test were all negative

A transection of the left, eleventh nerve was proposed with resection of one-half of the proximal end followed by suture of the remaining one-half into the entire peripheral end (Fig 2B)

Operation—October 17, 1935 Local anesthesia Oblique incision on the left side, paralleling the anterior border of the sternocleidomastoid muscle, which was followed downward for a distance of 10 cm The eleventh nerve was found entering the mesial surface of this muscle It was traced upward for 3 to 4 cm and found to consist of the entire trunk of the nerve, determined because of the absence of branches and by the effect of faradic stimulation The nerve was severed and a portion of the proximal end of the nerve stripped upward The remaining portion, approximately one-half, was sutured into the entire distal end with five black silk sutures Thereby, the number of functioning axones entering the peripheral end of the nerve was reduced by one-half

As a result there was a paralysis of the left sternocleidomastoid, and an almost complete paralysis of the left trapezius muscle It is to be noted that the trapezius muscle was not entirely thrown out of function, since the upper cervical nerves also contribute to the innervation of this muscle According to the patient, after three months, these muscles began to function again

Follow-up—July 18, 1936 It was noted that the head was held in a more normal position He stated that three months after operation there was a noticeable return of power in the left sternocleidomastoid muscle, and that "it would move independently," *i e,* rhythmic jerks took place at times but not powerful enough to move his head The trapezius movements are more powerful and tend to pull the head back a little, so that his chin is held higher than normal It was planned to carry out a similar operation on the right side to lessen the trapezius pull However, the patient did not return, as he felt so greatly improved

Case 2—Neurological Institute, No 16685 E J S, age 45, married, clerk, was first seen in the clinic, July 14, 1933, complaining of "spasm of the neck and pain in the left shoulder" The onset in May, 1933, was gradual and the course progressive The contractions were especially noted when walking A year ago, he became greatly upset, emotionally, upon being discharged from an Insurance Company, where he had been employed for 20 years This episode certainly furnished a suitable mental background for the development of a functional nervous disease At this time, while driving

a car, he could control the movements of his head and neck by placing his hand on the left trapezius muscle There was no acute infection preceding the onset of the torticollis, but he was sick for a week, in 1919, with influenza During this illness his temperature reached 101° F, but there was no diplopia or delirium He smokes half of a package of cigarettes a day and takes no other stimulants Frequently the patient's sleep is disturbed by screaming However, he is not conscious of his outcries His family life is normal and he has one child, age 13

Physical Examination—There were present irregular spasms of the left sternocleidomastoid, platysma and trapezius muscles, most pronounced while walking and less evident while lying down His occiput was drawn to the right, pointing the chin upward to the left There was hypertrophy of the right sternocleidomastoid and trapezius muscle All laboratory tests were negative *Diagnosis* Mild spasmodic torticollis, on an organic basis, which improved markedly with baking, faradism and deep massage

The patient was readmitted October 31, 1935, when it was found that the spasms of the right neck muscles had become more pronounced and, at times, very persistent Examination showed the occiput rotated to the right and backward which pointed the chin to the left The right shoulder was arched during the spasms There was pronounced hypertrophy of the right sternocleidomastoid and scapular division of the trapezius muscle With a little emotional activity, these muscles jerked violently, turning the head through 90° from right to left During this period of hospitalization, a very thorough attack from a mental standpoint was made upon his torticollis, but with no more than a very temporary effect upon the spasmodic movements

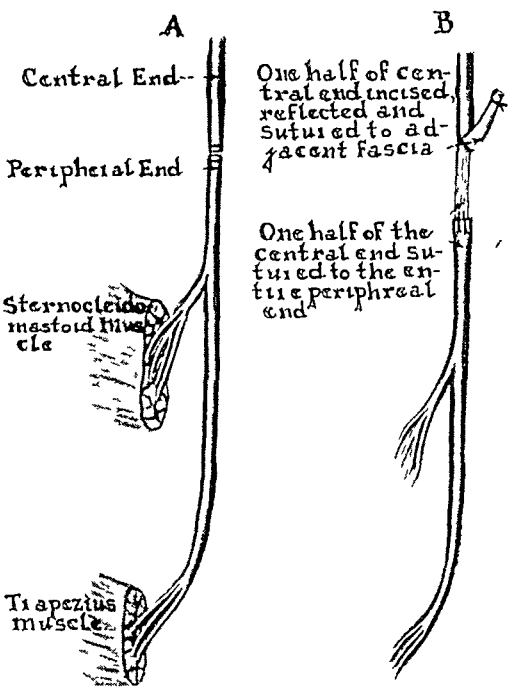


FIG 2—Drawing showing the technic of the surgical procedure employed in Cases 1 and 2

Operation—January 8, 1936 A section of the right spinal accessory nerve was accomplished The proximal end consisting of one-half of the total nerve was sutured into the entire distal end of the nerve (Fig 2B) Postoperatively, there was a paralysis of the right sternocleidomastoid and trapezius muscles The position of his head was more erect and he felt better He returned, February 20, 1936, to the surgical follow-up clinic and stated he was definitely improving On attempting to walk, there was a tendency for the former distorted position of the head and neck to recur It was thought advisable to operate, in addition, on the first, second, and third cervical roots, in order to accomplish a better result In June, 1936, the patient returned greatly improved, was able to hold his head erect, and power had returned in the right sternocleidomastoid and trapezius muscles There was a little increased tone in the sternocleidomastoid muscle but the irregular jerky movements were not present The involuntary movements in the right sternocleidomastoid and trapezius muscles when they did occur, induced by walking, were so weak that they did not affect the position of his head

CONCLUSIONS

A conservative method of treating spasmodic torticollis has been shown to give satisfactory results in two cases The method is similar to that used by

Dogliotti in treating the facial nerve for facial spasms of an organic nature namely, by a plastic reduction of motor fibers The operation is less hazardous than cervical root and intradural, spinal accessory nerve section If, in any case, a satisfactory result is not obtained, one may always resort to the latter procedure which stops spasmodic movements, but deprives the patient of considerable motor power in the neck and shoulders

REFERENCES

[1] Dogliotti, A M Guerison du spasme essentiel du nerf facial par reduction plastique des fibres motices Extrait des Bulletins et Memoires de la Societe Nationale de Chirugie Seance du 11 Juillet, 1934, Tome LX, No 25

[2] Gray's Anatomy Spitzka New American Edition, page 1009

COMPLETE SYMPATHETIC DENERVATION OF THE UPPER EXTREMITY

ALBERT KUNTZ, M D , PH D , WILLIAM F ALEXANDER, M S
ST LOUIS, MO

AND

CHARLES L FURCOLO, M D
SPRINGFIELD, MASS

FROM THE DEPARTMENT OF MICROANATOMY ST LOUIS UNIVERSITY SCHOOL OF MEDICINE ST LOUIS MO

SYMPATHETIC denervation of the extremities has become a recognized therapeutic measure in the surgical treatment of peripheral vascular disease The surgical procedures for sympathetic denervation of the upper extremity which have been employed most commonly during recent years involve extirpation of a portion of the sympathetic trunk including the inferior cervical ganglion and the first and second thoracic segments These procedures are based on current knowledge regarding the sources of the sympathetic fibers which supply the upper extremity These fibers leave the sympathetic trunk mainly through gray communicating rami which arise from the inferior and middle cervical sympathetic ganglia and join the nerves which make up the brachial plexus In a large percentage of cases, sympathetic fibers which arise below the inferior cervical ganglion also join the brachial plexus, mainly via an intrathoracic ramus of the second thoracic nerve which joins the first (Kuntz,[1] 1927) All the nerves extending from the brachial plexus into the upper extremity include sympathetic fibers The preganglionic neurons involved in the sympathetic innervation of the upper extremity are located in the upper thoracic region of the spinal cord, beginning with the first thoracic segment and extending downward at least as far as the third or fourth

The importance of complete sympathetic denervation of the upper extremity in the surgical treatment of diseases in which marked peripheral vasoconstriction is a major factor has been emphasized repeatedly Unsatisfactory clinical results due to incomplete sympathetic denervation of the extremity have also been reported in several instances

Extirpation of the portion of the sympathetic trunk including the inferior cervical ganglion and the first and second thoracic segments, commonly referred to as cervicothoracic sympathectomy, effects complete functional elimination of all sympathetic fibers which supply the upper extremity except possibly a few, in certain cases, which enter the vertebral canal below the second thoracic segment, ascend in it and join the anterior roots of nerves which contribute to the brachial plexus This has not been demonstrated anatomically in man, but has been demonstrated in cats by the use of experi-

Submitted for publication March 2, 1937

mental anatomic methods (Kuntz,[1] 1936) Observations reported following cervicothoracic sympathectomy in certain clinical cases also suggest that in man sympathetic fibers may enter the upper extremity from sources other than the cervical and first and second thoracic segments of the sympathetic trunk (Levy-Simpson, *et al*,[2] Telford,[5] 1934)

Cervicothoracic sympathectomy not only effects functional elimination of the sympathetic innervation of the upper extremity, but also of the corresponding side of the head and neck, due to interruption of the preganglionic fibers to the middle and superior cervical ganglia, thus producing an unwanted Horner's syndrome and abolishing perspiration in the area affected It also results in degeneration of the majority of the sympathetic fibers in the upper extremity, due to removal of the ganglion cells from which they arise Following degeneration of the vasomotor fibers, the vascular musculature becomes sensitized to adrenin, consequently, its tonus is markedly increased in response to adrenin in the circulating blood (Smithwick, Freeman and White[4]) The clinical results of sympathetic denervation, in many cases in which the operative treatment has been applied to both the upper and lower extremities, have been less satisfactory in the upper extremities than in the lower This probably can be explained most satisfactorily on the assumption that the vascular musculature in the upper extremity became hypersensitive to adrenin in the circulating blood following degeneration of the vasomotor fibers Sympathetic denervation of the lower extremity by the surgical procedure usually employed does not involve extirpation of the ganglion cells from which the vasomotor fibers to the extremity arise, consequently, the vascular musculature in the lower extremity does not become sensitized to adrenin

In order to avoid the unwanted effects of extirpation of the inferior cervical and upper thoracic sympathetic ganglia, particularly Horner's syndrome and sensitization of the vascular musculature to adrenin, but still secure functional sympathetic denervation of the upper extremity, Telford,[5] in 1935, advised section of the white communicating rami of the second and third thoracic nerves and crushing and division of the sympathetic trunk below the third thoracic ganglion, leaving the white communicating ramus of the first thoracic nerve, the sympathetic trunk ganglia and the gray communicating rami which join the nerves making up the brachial plexus intact Smithwick[3] has described an operative procedure designed to effect functional sympathetic denervation of the upper extremity which differs somewhat from that outlined by Telford In this operation, the roots of the second and third thoracic nerves are divided proximal to the communicating rami and a short segment of each nerve is resected The sympathetic trunk also is divided below the level of the third thoracic nerve, but none of the sympathetic trunk ganglia are removed and the gray communicating rami joining the nerves which make up the brachial plexus remain intact This operation interrupts none of the preganglionic components of the first thoracic nerve Its early clinical results in 11 patients, according to Smithwick, indicate that

few if any preganglionic components of the first thoracic nerve are involved in the sympathetic innervation of the hand

The assumption that preganglionic components of the first thoracic nerve play no significant part in the sympathetic innervation of the upper extremity is not in accord with current teaching In view of this fact and the importance of complete functional sympathetic denervation of the upper extremity in the surgical treatment of peripheral vascular disease, it has seemed desirable to obtain additional data regarding the distribution of the preganglionic components of the upper thoracic nerves by means of animal experimentation

Methods and Results—Preparations for the anatomic study of the distribution of preganglionic fibers in the inferior cervical ganglion have been obtained from cats Some of these animals had been subjected to unilateral section of the roots of the second and third thoracic nerves proximal to the communicating rami, resection of a short segment of each of these nerves and division of the sympathetic trunk below the level of the third thoracic nerve The others had been subjected to unilateral section of the roots of the first thoracic nerve and resection of a short segment of this nerve, including the origin of its white communicating ramus The sympathetic trunk remained intact These operations were carried out under aseptic conditions and the animals were allowed to live long enough (14 to 21 days) to insure degeneration of all interrupted preganglionic fibers The inferior cervical ganglia were then prepared for study by means of a modified Cajal silver technic

Preparations of the inferior cervical ganglia taken from the animals which had been subjected to the first operative procedure outlined above show complete degeneration of all the preganglionic fibers entering the ganglion at its inferior pole The major portion of the intercellular fiber complex in the portion of the ganglion supplied by these fibers also has undergone degeneration, and the portion of the sympathetic trunk above the inferior cervical ganglion shows many degenerated fibers, indicating that many preganglionic fibers which arise below the level of the first thoracic segment continue upward in the cervical portion of the sympathetic trunk The portion of the inferior cervical ganglion adjacent to the area through which the white ramus of the first thoracic nerve enters it shows no evidence of fiber degeneration (Fig 1) The intercellular fiber complex in this portion of the ganglion is entirely comparable to that of the inferior cervical ganglion on the unoperated side

Preparations of the inferior cervical ganglia taken from the animals which had been subjected to the second operative procedure outlined above show complete degeneration of all the preganglionic fibers entering the ganglion through the white communicating ramus of the first thoracic nerve The major portion of the intercellular fiber complex in the portion of the ganglion adjacent to this ramus (Fig 2) and a large percentage of the fibers in the portion of the sympathetic trunk above the inferior cervical ganglion also have undergone degeneration At the inferior pole and in the adjacent por-

tions of the ganglion the intercellular fiber complex is entirely comparable to that in the corresponding portions of the ganglion on the unoperated side

The above observations support the current view that the preganglionic fibers which effect synaptic connections with ganglion cells in the inferior cervical ganglion include components of the first thoracic as well as components of lower thoracic nerves The portion of the ganglion in which the intercellular fiber complex undergoes degeneration following section of the white ramus of the first thoracic nerve, furthermore, includes large numbers of ganglion cells Some preganglionic fibers of lower origin probably effect

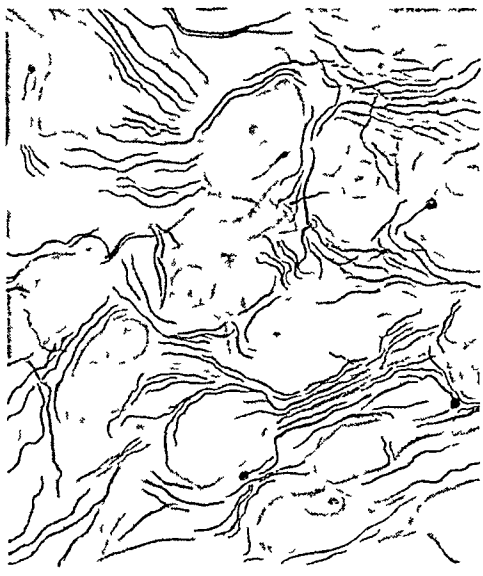


FIG 1.—Drawing from a section of the inferior cervical ganglion of the cat adjacent to the area through which the white communicating ramus of the first thoracic nerve enters it, following degeneration of all preganglionic fibers arising below the first thoracic segment



FIG 2.—Drawing from a section of the inferior cervical ganglion of the cat adjacent to the area through which the white communicating ramus of the first thoracic nerve enters it following degeneration of only the preganglionic fibers of the latter ramus

synaptic connections in this portion of the ganglion, but the number of ganglion cells with which preganglionic components of the first thoracic nerve effect synaptic connections obviously is large The distribution within the ganglion of the axons arising from these ganglion cells, furthermore, indicates that many of them enter gray rami which join the nerves which make up the brachial plexus

Physiologic experiments in which the effects on the eye and the blood vessels and sweat glands of the upper extremity of direct stimulation of the preganglionic fibers in the first, second and third thoracic nerves were observed have been carried out on both cats and dogs With the animal under anesthesia, the upper three or four thoracic nerves were exposed by incision lateral to the vertebral column and resection of the corresponding ribs A galvanic current of threshold strength for the preganglionic fibers was used as stimulus The electrode was applied at the cut surface of the distal portion of the divided ventral root In case of the second and third thoracic nerves, it was some-

times applied at the cut surface of the distal portion of the ventral root and sometimes to the white communicating ramus

Stimulation of the ventral root of either the first or the second thoracic nerve consistently resulted in dilatation of the pupil and retraction of the nictitating membrane Stimulation of the ventral root of the third thoracic nerve resulted in retraction of the nictitating membrane but not in dilatation of the pupil Section of the roots of either the first or the second thoracic nerve alone or its white communicating ramus did not produce Horner's syndrome, but section of the roots or white communicating rami of both these nerves consistently resulted in a complete Horner's syndrome

Stimulation of the ventral root of either the first, the second or the third thoracic nerve resulted in activation of sweat glands in the paw pads and constriction of cutaneous vessels of the foot The exact distribution of the sweat glands and cutaneous vessels affected by stimulation of each nerve separately has not been determined It is significant, however, that sweating elicited by stimulation of the preganglionic fibers of the first thoracic nerve was apparent on all parts of the paw pads

In certain experiments, using both cats and dogs, the distal portion of the ulnar artery was exposed and its reactions to stimulation of the ventral roots of the first and second thoracic nerves separately were observed under low magnification Stimulation of either root resulted in marked constriction of the artery

In one series of experiments carried out on dogs, kymographic records were made of the changes in blood pressure in the distal portion of the ulnar artery in response to stimulation of the ventral root of the first thoracic nerve Simultaneous records of the general blood pressure also were made These records indicate an initial increase followed by a decrease in pressure in the ulnar artery, without any change in the general blood pressure The initial increase in pressure in the ulnar artery obviously is due to the contraction of its musculature in response to stimulation of preganglionic components of the first thoracic nerve, the decrease in pressure following the initial increase is probably due to the reduction in the volume of the blood flowing through the constricted artery

Comment.—The anatomic data set forth above shows clearly that preganglionic components of the first and lower thoracic nerves effect synaptic connections in the inferior cervical sympathetic ganglion and that the fibers which extend upward in the cervical sympathetic trunk include preganglionic components of the first and lower thoracic nerves This is in accord with current anatomic teaching The responses of the iris to stimulation of the ventral roots of the first and second thoracic nerves indicate that both these nerves include preganglionic fibers involved in the sympathetic innervation of the eye This also is in accord with current teaching The absence of Horner's syndrome following section of the roots of either the first or the second thoracic nerve alone indicates that the normal tonus of the dilator pupillae muscle may be maintained through the preganglionic components of either of

these nerves Both the anatomic and the physiologic findings indicate that preganglionic components of the first thoracic nerve play an important rôle in the sympathetic innervation of the upper extremity both with regard to the sweat glands and the vascular musculature

Comparative anatomic and physiologic data, as far as such data are available, indicate a close correspondence in the distribution of the preganglionic components of the thoracic nerves in the carnivora and man If the distribution of the preganglionic fibers of the first thoracic nerve in man corresponds to the distribution of these fibers in the cat and the dog, sympathetic denerva-

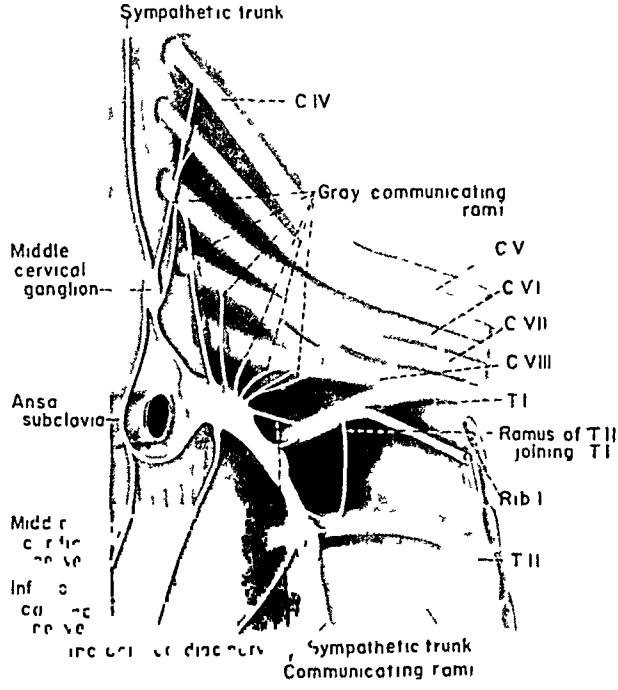


Fig 3 —Drawing from a human dissection illustrating the anatomic relationships of the sympathetic trunk and communicating rami to the nerves of the brachial plexus

tion of the blood vessels of the upper extremity in man obviously cannot be accomplished by any operative procedure which leaves intact the first thoracic nerve with its communicating ramus and the inferior cervical ganglion with the gray communicating rami which connect it with the nerves which make up the brachial plexus (Fig 3)

In view of the damaging effect of sensitization to adrenin of the vascular musculature following degeneration of the postganglionic vasomotor fibers in cases of vascular disease in the upper extremity, it must be regarded as advantageous to leave the sympathetic trunk ganglia *in situ* in order to avoid interruption of the gray communicating rami which join the nerves making up the brachial plexus Interruption of the white communicating ramus of the first thoracic nerve, in addition to interruption of the white communicating ramus of the second thoracic nerve and division of the sympathetic trunk

below the level of the second thoracic ganglion, is essential to insure complete functional sympathetic denervation of the upper extremity If the sympathetic trunk is divided between the second and third thoracic ganglia, section of the communicating ramus of the third thoracic nerve, according to our present knowledge, can have no effect in the sympathetic denervation of the upper extremity unless fibers arising in the third thoracic ganglion ascend in the vertebral canal and join nerves which contribute to the brachial plexus

SUMMARY —The preganglionic fibers which effect synaptic connections in the inferior cervical sympathetic ganglion include components of the first and lower thoracic nerves Preganglionic components of the first and lower thoracic nerves also extend upward in the cervical portion of the sympathetic trunk These findings are in agreement with current teaching

The axons of inferior cervical ganglion cells with which preganglionic components of the first thoracic nerve effect synaptic connections are relatively widely distributed in the upper extremity, particularly its distal portions, both to the vascular musculature and the sweat glands If the inferior cervical sympathetic ganglion and the gray communicating rami connecting it with the brachial plexus are left intact, complete functional sympathetic denervation of the upper extremity cannot be effected without interruption of the white communicating ramus of the first thoracic nerve

REFERENCES

[1] Kuntz, A Distribution of the Sympathetic Rami to the Brachial Plexus Its Relation to Sympathectomy Affecting the Upper Extremity Arch Surg, 15, 871–877, 1927

——— The Autonomic Nervous System, 2nd ed Lea and Febiger Co, Philadelphia, 1934

——— The Autonomic Nervous System, Essential Anatomy, J A M A, 106, 345–350, 1936

[2] Levy-Simpson, S, Brown, G E, and Adson, A W Observations on the Etiologic Mechanism in Raynaud's Disease Proc Staff Meet, Mayo Clin, 5, 295–298, 1930

[3] Smithwick, R H Modified Dorsal Sympathectomy for Vascular Spasm (Raynaud's Disease of the Upper Extremity ANNALS OF SURGERY, 104, 339–350, 1936

[4] Smithwick, R H, Freeman, N E, and White, J C Effect of Epinephrine on the Sympathectomized Human Extremity Arch Surg, 29, 759–767, 1934

[5] Telford, E D Sympathectomy A Review of One Hundred Operations Lancet, 444–446, 1934

——— The Technique of Sympathectomy Brit Jour Surg, 23, 448–450, 1935

THE PROPHYLACTIC AND ACTIVE USE OF ZINC PEROXIDE IN FOUL SMELLING MOUTH AND NECK INFECTIONS*

FRANK L MELENEY, M D
NEW YORK N Y

THERE are certain infections of the mucous membrane of the mouth and throat in whose pathogenesis *anaerobic and micro-aerophilic organisms* play a prominent part These organisms are frequently found in mouths which are not kept in good hygienic condition They may also be found in mouths which are apparently normal, but are more often observed where there is dental caries, or root infection, or where there is persistent irritation of the gums from deposits upon the teeth These organisms frequently take part in the inflammatory process in the gums as in cases of pyorrhea, or in the ulcerated infections of the tongue and cheek, commonly called stomatitis Whether they are primary invaders of normal tissue like the hemolytic streptococcus or the diphtheria bacillus is not known, but they frequently invade the tissues when there has been a break in the primary defenses of the mucous membrane, caused either by a foreign body such as a splinter, fish bone, tooth or a fractured jaw, or following an operative procedure such as tonsillectomy or tooth extraction When such an invasion takes place they may simply produce a diffuse inflammation of the submucous tissues or they may cause necrotic ulcers which destroy large portions of the mucous membrane, or they may course through the lymphatics to the cervical lymph nodes, or they may spread by direct extension through the tissues causing extensive necrosis either downward through the floor of the mouth and into the neck or upward into the face, not infrequently extending into the orbit or beneath the temporal muscle into the pericranial tissues

If the infection manifests itself as a severe cellulitis of the submucous tissues, either of the mouth or of the throat, it gives the typical picture described by Plaut[1] and by Vincent,[2] commonly known as "Vincent's angina" If the germs invade the floor of the mouth and burrow down into the tissues of the neck or invade the lymph nodes of the neck, they may threaten or produce a closure of the glottis which is called "Ludwig's angina"[3]

Differential Diagnosis—Mild forms of inflammation of the mucous membrane of the mouth occur in patients after prolonged vomiting or prolonged starvation The digestive action of gastric juice may produce ulcers in the mouth or on the lips which do not persist long after the vomiting ceases In starvation cases the stomatitis has been attributed to lack of vitamins, and this is confirmed by the favorable response following the administration of these substances in many cases Smears and cultures from these lesions usually do not reveal the activity of *anaerobic or micro-aerophilic organisms*

* Read before the New York Surgical Society, February 10, 1937 Submitted for publication April 22, 1937

The hemolytic streptococcus commonly produces a diffuse cellulitis of the tissues of the throat and not infrequently spreads to the neck By the rapid development of edema frequently threatens or produces a closure of the glottis, but there is usually no necrosis of the mucous membrane or of the deep tissues of the neck, and the odor of the exudate is not foul Infections in which the *anaerobic or microaerophilic organisms* are playing the dominant rôle, result in both necrosis of the mucous membrane and necrosis of the deeper tissues, and the exudate has a rather characteristic and very offensive putrid odor Usually the hemolytic streptococcus infections produce a high fever and a profound intoxication, while the infections due to the *anaerobic and microaerophilic organisms* produce less fever and less intoxication, and a more distressing and extensive destruction of tissue The hemolytic streptococcus infections are very apt to arise acutely and rapidly subside, while the *microaerophilic and anaerobic infections* are more apt to develop slowly, spread insidiously and resolve less rapidly

Bacteriology—Anaerobic as well as aerobic cultures in the hemolytic streptococcus infections reveal large numbers of those organisms The ordinary aerobic cultures in the foul smelling infections usually yield the ordinary mouth organisms with the nonhemolytic streptococcus predominating However, if a dark field illumination is used for examination of the exudate, fusiform bacilli, spirilla, or spirochaetae may be seen Both *Treponema macrodentium* and *Treponema microdentium* are found The spirochaetae are almost always present in the severest cases, but may be absent from the mildest forms When anaerobic cultures are made, nonhemolytic streptococci are usually found on the blood agar plates which are either strictly anaerobic or microaerophilic With the special media recommended by Smith[4] and others, the fusiform bacilli, spirilla and spirochaetae may be obtained The fusiform bacilli grow out in 48 hours in plain cooked meat medium to which 10 per cent ascitic fluid has been added The spirochaetae grow out in eight to ten days in 33 per cent sheep or beef serum in distilled water to which a bit of sterile rabbit kidney has been added *These organisms are not pathogenic when injected into animals in pure culture, but when they are combined they have a synergistic action which produces a more or less extensive lesion*

The odor of the lesion arises from the development of gases by the bacterial action on the tissues When these organisms are cultivated artificially it is found that the nonhemolytic anaerobic streptococcus is the only one which in pure culture will produce a foul odor The spirochaeta *T microdentium* produces an unpleasant odor but it is not foul When the streptococci and the spirochaetae are combined, the odor is very foul and resembles that coming from the infected tissues

Treatment—When *the anaerobic and microaerophilic organisms* are present in the mouth unaccompanied by any inflammation, they may be minimized or eliminated by a number of oxidizing agents such as potassium chlorate, potassium permanganate, or sodium perborate, but they are more quickly and more effectively eliminated by the use of zinc peroxide When, however, there

is an infection either mild or grave with an invasion of the submucous tissues, and superficial ulceration of the mucous membrane, zinc peroxide is much more effective in treatment than the other oxidizing substances When the infection has spread to the deeper layers either directly or through the lymphatics, surgery is required and *should be radical*, extending well beyond the area of indurated tissue and opening the involved facial spaces It is frequently necessary to remove masses of lymph nodes or the submaxillary salivary glands in order to effect the proper drainage If the incisions have not been carried to the limit of the necrosis, it will continue to spread and cause a great deal more destruction This has been illustrated over and over again when conservative operations have been attempted, in the dental clinic for example, and the cases have had to be subsequently taken into the hospital for more extensive surgery When the tissues have been opened by adequate surgery, however, the infection can be brought under control by the careful application of *zinc peroxide suspended in sterile distilled water, to every part of the infected* surface If this is done, the foul odor will almost immediately disappear, and smears and cultures of the exudate will show rapidly decreasing numbers of the spirochaetae, fusiform bacilli and the anaerobic streptococci

The zinc peroxide must be an effective preparation as shown by preliminary tests[8] indicating its ability to liberate oxygen when suspended in distilled water * It should be sterilized in small quantities at 140° F dry heat for four hours, and applied as follows The dry powder is suspended in approximately an equal quantity of water so that it has the consistency of 40 per cent cream It can be suspended evenly with an "Asepto" syringe and applied with the syringe to every part of the wound surface If there are any sinuses, it should be delivered into them through a catheter, but if there are any parts of the infection which cannot be reached, it will have to be opened up so as to permit contact, which is essential When the whole surface of the wound has been covered, fine meshed gauze soaked in zinc peroxide should be placed over the surface, and the whole wound sealed with several layers of Vaseline gauze so as to prevent evaporation The dressing should be changed daily When the gauze is removed, at the end of 24 hours, the old zinc peroxide and exudate should be washed off with saline from an irrigating can The zinc peroxide suspension is then applied as before This technique has been more fully described in previous papers [5, 6 7, 8 9]

The zinc peroxide should also be used at the same time, as a mouth wash, about one part powder to four parts water One mouthful every three or four hours coats the mucous membrane very well This should be thoroughly spread around the surface of the mouth If there are any lesions on the tonsillar walls or pharynx, it should be applied with a cotton swab Gargling or swishing the material around in the mouth will usually not result in contact with the tissues back of the anterior pillar of the fauces

When the smears and cultures have become entirely negative for patho-

* The only dependable product available at present is the *"medicinal grade"* of zinc peroxide made by the DuPont Chemical Company, Niagara Falls, N Y

genic organisms, simple dressings will be satisfactory Our experience with these cases during the past two years has demonstrated the superiority of this treatment over any previous treatment First, in the rapid subsidence of acute general symptoms, second, in the rapid resolution of the local process, third, in the rapid disappearance of the foul odor which is so offensive to the patient and to other patients in the neighborhood, and fourth, in the rapid healing of the wound

We believe that zinc peroxide should be used as a prophylactic mouth wash in all cases preliminary to tonsillectomy or dental extraction It is logical to believe that these serious infections would be greatly diminished if this were employed extensively Preliminary studies of the flora of the mouth should demonstrate the presence of the offending organisms, and if they are present, treatment should be instituted a day or two before the operative procedure is carried out, until the organisms have largely or, if there is time, until they have completely disappeared

ILLUSTRATIVE CASE REPORTS

Case 1—No 502485 J S, female, married, age 20, was admitted to the hospital with symptoms and signs simulating acute appendicitis At the operation, a relatively normal appendix was removed The symptoms continued and subsequent studies seemed to indicate that they were of rheumatic origin She was transferred to the medical service and during the course of her treatment it was thought advisable to remove several bad teeth, two in the left upper jaw were removed without incident and five days later three in the left lower jaw were extracted

Next day the jaw pained severely and swelling appeared in the cheek and neck The temperature rose on the second day to 101°F and the white blood count to 14,500, with 87 per cent of polymorphonuclears The swelling spread over to the right side of the neck and into the floor of the mouth very rapidly during the next 24 hours, and difficulty in swallowing and breathing began to be experienced Under chloroform anesthesia, Dr Rudolph Schullinger made a curved incision over the submental and submaxillary triangles The submaxillary salivary glands were removed and the tissues beneath the floor of the mouth were exposed, from which pus and seropurulent fluid without much odor drained Dakin's fluid was instilled through drainage tubes for two days with some improvement, but then the exudate took on the typical foul odor of anaerobic infections

On the fifth day zinc peroxide applications were started The foul odor promptly disappeared and the wound showed marked improvement Thereafter healing progressed rapidly and the patient left the hospital on the eighteenth day

No dark field examination was made of the pus obtained at the time of the operation, nor in fact until the day after the zinc peroxide treatment was begun Then fusiform bacilli were found in the pus but they did not grow out in the anaerobic culture which yielded hemolytic streptococci, green streptococci and *Staphylococcus albus* Five days later only the green streptococci remained, and two days later the cultures yielded no growth

Case 2—No 509567 R S, female, age 20, had had the left lower third molar removed without incident three weeks previous to admission Two days before, the right lower third molar had been removed It had an overhanging gum Next day the submaxillary and sublingual tissues began to swell On the day of admission she began to have difficulty in swallowing Her temperature rose to 102°F, W B C to 25,700, and her pulse was 92 The tissues under the mandible were hard and tender Cold applications were made for 24 hours, but her temperature remained above 103° F all day and in the evening rose to 104° F, W B C to 33,000, and pulse to 89

Operation—The submental triangle was opened by the oral surgeon The tissues over the right submaxillary gland were cut Necrotic foul smelling material was found in the submental region, and the wound was dressed with Dakin's solution The temperature fell to 101° F after operation but mounted again to 103° F next day, later falling to 101° F There was slight general improvement but the swelling under the tongue increased, swallowing became more difficult, and the foul odor of the discharge was most distressing It was obvious that a deeper and wider incision would be necessary, and she was referred to me for operation which was done, under chloroform anesthesia The submaxillary triangles were opened and foul pus evacuated Part of the right submaxillary gland and the necrotic submental nodes were removed, the wound was flushed with zinc peroxide suspension and then packed with gauze soaked in the same material, two rubber tubes being placed in each submaxillary triangle Thereafter the temperature steadily fell, the edema subsided, the foul odor disappeared, the necrotic tissue separated and the swallowing rapidly improved Eleven days after the last operation the granulations were active and the wound was healing rapidly

A dark field examination of the pus revealed spirochetae, fusiform bacilli, vibrios and cocci The cultures yielded anaerobic hemolytic streptococci, fusiform bacilli and green streptococci

On the sixth day only a few anaerobic streptococci and fusiform bacilli were found on the right side and none on the left On the eleventh day the smears and cultures were negative for these organisms

REFERENCES

[1] Plaut, H C Le bacille fusiforme et le spirillum sputigenum dans les angines ulcereuses Compt rend Soc de Biol, 58, 805, 1905

[2] Vincent, H Recherches bacteriologiques sur l'angine a bacilles fusiformes Ann de l'Instit Pasteur, 13, 609, 1899

[3] Ludwig, W F Ueber eine neue Art von Halsentzundungen Wurtt Korrespondenzbl, 6, No 4, 1837

[4] Smith, D T Oral Spirochetes and Related Organisms in Fuso-spirochetal Disease Baltimore, 1932, Williams & Wilkins Co

[5] Meleney, F L Zinc peroxide in the treatment of Micro-aerophilic and anaerobic infections with special reference to a group of chronic ulcerative burrowing non-gangrenous lesions of the abdominal wall ANNALS OF SURGERY, 101, 997, 1935

[6] Meleney, F L Zinc peroxide in surgical infections S Clin North America, 16, 691, 1936

[7] Meleney, F L, and Johnson, B A The prophylactic and active treatment of surgical infections with zinc peroxide Surg, Gynec & Obst, 64, 387, 1937

[8] Meleney, F L, and Johnson, B A Further laboratory and clinical experiences in the treatment of chronic, undermining, burrowing ulcers with zinc peroxide Surgery, 1, 169, 1937

[9] Meleney, F L Use of zinc peroxide in oral surgery International Jour Ortho & Oral Surg, 23, 932, 1937

DISCUSSION—DR I S RAVDIN (Philadelphia) expressed his appreciation of the opportunity to say a few words in regard to the use of zinc peroxide in the control of infections due to anaerobic and micro-aerophilic organisms His experience with the use of this substance began shortly after Doctor Meleney obtained his first potent preparation The results in the early cases were variable, and all must be deeply in Doctor Meleney's debt not only for demonstrating the efficacy of this method of therapy, but also for seeing to it that the manufacturers finally provided a uniformly potent material

The invasiveness of these organisms once they have gained a foothold is well known to all who have had the opportunity of observing their activity

In the region described by Doctor Meleney, they may not only involve the orbit and periorbital tissues but they may also cause extensive necrosis of the facial bones and the calvarium

It has been Doctor Ravdin's impression that the micro-aerophilic streptococci are frequently not primary invaders of an intact mucous membrane but that they invade the submucous tissues once the primary defense of an intact mucosa has been destroyed Doctor Meleney has pointed out certain of the important characteristics in the differential diagnosis of the hemolytic streptococcus infections of the mouth and neck and those due to the anaerobic and micro-aerophilic streptococci This was probably not meant to imply that the two types of organisms are not at times found simultaneously in infections of the floor of the mouth In such instances there is rapid invasion with considerable edema and necrosis The systemic effect is often profound and the true nature of the combined infection is often not appreciated until the more rapidly invading hemolytic streptococcus is brought under control and there remains the more slowly progressing, necrotizing lesion which results from the micro-aerophilic organisms

Doctor Meleney very rightly pointed out that zinc peroxide is not in itself a panacea It does not take the place of sound surgery when an extensive infection exists in the hyomandibular and cervical tissues The advantages of zinc peroxide over other substances which liberate oxygen lie in several directions First, the oxygen is liberated more slowly, and second, the salt which is formed as the oxygen is liberated is not in itself injurious to the tissues One does not observe, therefore, the tissue injury which may result from the use of perborate or potassium chlorate solutions

It is only fair to state that the excellent results which have been obtained by many, which amply verify Doctor Meleney's observations, could not have been achieved had zinc peroxide not been used with the same care with which Doctor Meleney uses it The treatment demands the utmost care—more than is usually given by a junior house officer

Dr Henry S Dunning (New York) called attention to the fact that a great many postextraction infections are seen at the Columbia Dental School, and are probably increasing They are very severe and an effort has been made for a long time to impress on the dental profession the necessity of removing infected teeth with the least possible amount of traumatism and without in any way, if possible, damaging the membrane around an apical abscess It is realized that these are full of dynamite, as also are infections around third molars If the third molar stays in the gum a long time, a flap of gum forms over it, under that an ulcer forms, and in this a mixed infection may develop, as a rule with Vincent's spirilla predominating Until recently treatment of these has been with Dakin's solution and perborate of soda for some time before the extraction period Sometimes these flaps are so large that they are traumatized by biting against them It is very serious to operate upon a case and take out these submerged third molars before the condition subsides and the gum is less swollen However, the patient is suffering a great deal of the time Almost immediately after the tooth is removed, the flap of gum drops in the wound and that is the end of it—unless infection develops

In one of the patients described this evening, which Doctor Dunning treated with Doctor Meleney, a true Ludwig's angina developed very rapidly Doctor Dunning had another case that in four days resisted the most radical surgery that could be instituted and ended fatally

The postoperative treatment of the wounds in postextraction cases is of

vital importance Some of the cases encountered in the Oral Surgery Clinic have been operated upon carefully and followed up a few days, but others have gone untreated, some have been packed, and some curetted Doctor Dunning said he could not speak strongly enough against packing or anything that will prevent drainage or a blood clot forming in the alveolus of the bone He had been advocating leaving them wide open, putting in nothing at all except, perhaps, a sponge between the teeth in cases of hemorrhage, and having the patient bite on it, then washing the wounds until they absolutely heal up A certain number of these wounds will go on to infection whether they have had good treatment or not If they do go on to a Ludwig's angina or to a large subperiosteal abscess, then incision and drainage should be instituted at once in a hospital as soon as the case is seen These mouth infections have been treated with permanganate, perborate of soda Dakin's solution, zinc peroxide, and other agents, and in the cases Doctor Dunning has seen, zinc peroxide has given the best results It has been much more efficient in cleaning up these foul smelling wounds than anything else he had ever seen In infected jaws with osteomyelitis it has done more than anything ever known, and particularly in the type of case shown at this time has it been very, very successful in helping to clear up the infection Doctor Meleney should receive united thanks for all the work he has done in bringing the use of zinc peroxide to the attention of the profession

GLOSSITIS RHOMBICA MEDIANA

HAYES E MARTIN, M D AND M ELIZABETH HOWE, M D
NEW YORK, N Y
FROM THE HEAD AND NECK SERVICE MEMORIAL HOSPITAL NEW YORK

GLOSSITIS RHOMBICA MEDIANA IS a benign disease of the tongue characterized by the presence of a mass or plaque, ovoid or rhomboid in shape, situated in the midline of the dorsum of the tongue, just anterior to the V formed by the vallate papillae There are usually no subjective symptoms, and the condition is commonly discovered by the physician or dentist, or even by the patient himself, in the course of an incidental examination of the oral cavity

The process appears to be incidental and of little or no clinical significance, except that the diagnosis may be confused with that of cancer of the tongue Of the 11 cases presented in this report, ten were referred to the Memorial Hospital with the tentative diagnosis of cancer of the tongue Our purpose is to describe the characteristic features of glossitis rhombica mediana, and to point out that it may be readily differentiated clinically from cancer

The condition was first described, in 1914, by Brocq and Pautrier,[1] who reported 17 cases under the title "glossite losangique mediane de la face dorsale de la langue" Subsequently sporadic case reports appear in the literature, until 1922, when Arndt[2] recorded one case and mentioned that 40 others of similar nature had been observed in an 18 months' period at the Skin Clinic of the University of Berlin In 1923, Fordyce and Cannon[3] described two cases of a lesion of the dorsum of the tongue, previously unknown to them, which clinically and histologically seems typical of the condition now under discussion In 1924, Lane[4] reported one case, and by modifying and shortening the original title given to it by Brocq and Pautrier, gave to the disease the still rather cumbersome name "glossitis rhombica mediana," by which it is now commonly known in the American literature Zimmerman[5] reviewed the subject, in 1929, on the basis of 29 cases collected from the literature Since 1929, Abshier[6] and Loos and Horbst[7] have each recorded one case In 1934, Gougerot and Dechaume[8] reported a series of lingual plaques which they considered typical of the dorsal glossitis of Brocq and Pautrier, of which some were not rhomboid and others were not located in the midline They concluded that these "placques depapillees" were atypical or attenuated forms of glossitis rhombica mediana In the present report, we have excluded all such atypical forms as being confusing and irrelevant

It appears probable that Spencer and Cade[9] have not recognized clinically the lesion which is now generally designated as "glossitis rhombica mediana" They use the latter term to describe a condition in which the rhomboid area on the dorsum of the tongue becomes coated with a "heavy fur" because "this por-

tion of the tongue is least pressed against the palate or scrubbed against the teeth" Obviously, the phenomenon which they describe is a natural and common consequence of limitation in the normal range of tongue movement following any painful form of glossitis (cancer, sepsis, radiation reaction, *etc*) The presence of a heavy fur in the rhomboid area is the exact opposite of the nonpapillated, relatively smooth and pink appearance generally considered as being characteristic of glossitis rhombica mediana Neither Butlin[10] nor Blair[11] makes any mention of a tongue lesion which in any way resembles the condition now under discussion

Incidence—The condition is comparatively rare, or at least seldom recognized Including our series of 11, there are reported in the literature a total of 42 cases In our clinic, the incidence is less than 1 per cent of all patients referred for diagnosis and treatment of suspected cancer of the tongue

TABLE I

AGE INCIDENCE AND SEX DISTRIBUTION OF ALL REPORTED CASES OF GLOSSITIS RHOMBICA MEDIANA

Age	15–20		21–30		31–40		41–50		51–60		—Total—		
Sex	M	F	M	F	M	F	M	F	M	F	M	F	Both
Zimmerman (Collected series)	0	3	3	0	8	4	5	0	6	0	22	7	29
Abshier									1		1		1
Loos and Horbst								1				1	1
Martin and Howe					4		4	2	1		9	2	11
All cases	0	3	3	0	12	4	9	3	8	0	32	10	42

Age and Sex—Glossitis rhombica mediana appears to be a disease mainly affecting middle aged males In our series, there were nine males (82 per cent) and two females (18 per cent) In Zimmerman's collected series of 29 cases, there were seven (24 per cent) females Loos and Horbst's single case occurred in a female The average age in our series was 43—the youngest patient being 35 and the oldest 57, with ten of the 11 cases between the ages of 35 and 50 In Zimmerman's collected series, there were three females below the age of 20 and three males below the age of 30

ETIOLOGY—*Predisposing Causes*—In our opinion, there is little or no evidence that this disease develops as the result of any of the common forms of chronic irritation In all of our patients, there was a noteworthy absence of the usual sequelae of chronic irritation in the form of leukoplakia or diffuse glossitis The incidence and degree of dental sepsis and the "coating" of the tongue in our series were about the same as those of the corresponding age and social group The Wassermann reaction was found to be negative in all of our patients This is contrary to the findings of Brocq and Pautrier, Dubreuilh,[12] May,[13] and Fordyce and Cannon, but in all of these reports, it is significant that the process remained indifferent to vigorous and prolonged antiluetic therapy All of our male patients had used tobacco and a similar

history is noted in the reports of others, but we feel that the absence of leukoplakia in all of our cases probably eliminates this source of chronic irritation as an etiologic factor Since, in our opinion, there is so little evidence in support of an inflammatory or irritative origin for glossitis rhombica mediana, we have sought for an embryologic explanation, and have felt that it might possibly represent a persistence of the tuberculum impar

Embryologic Development—The tongue, embryologically, is a pharyngeal derivative—a "mucous membrane sac which becomes stuffed with skeletal

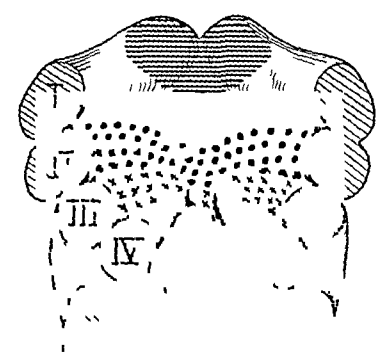


Fig 1
DERIVATIONS OF THE PARTS OF THE TONGUE

From Ist branchial arch
Tuberculum impar
Foramen cecum
From IInd branchial arch
From IIIrd branchial arch

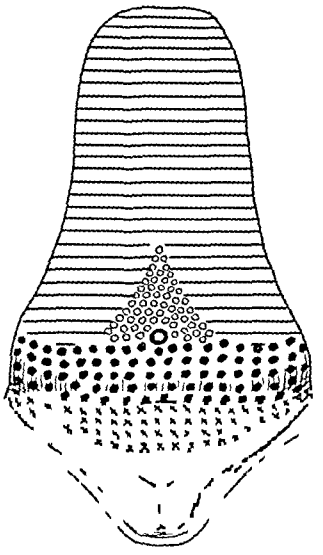


Fig 2
The developing tongue

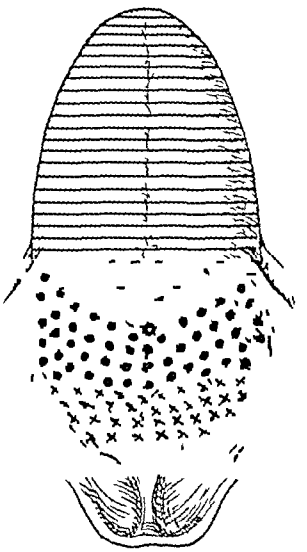


Fig 3
The adult tongue

FIGS 1, 2 and 3—Drawings showing the embryologic development of the tongue (after Arey)

muscle" The mucosa of the body or apical half arises from three primordia the paired lateral swellings of the first or mandibular arches, and from the median somewhat triangular tuberculum impar which forms the pharyngeal floor between the first pair of branchial pouches The mucosa of the root arises from a median ventral swelling, the copula, formed by the union in the midline of the second branchial arches It receives some tissue from the third and fourth arches as well (Fig 1) The mucosa of the apical half is papillae bearing, that of the root becomes infiltrated by lymphoid tissue The body and root are demarcated from each other by the sulcus terminalis

The tuberculum impar, in embryo, forms the posterior medial portion of the apical half and is in contact and continuity with the copula Between these two is the point of origin of the thyroid diverticulum which, with fetal growth, becomes depressed into a pit and forms the foramen cecum (Fig 2) As development proceeds, the paired lateral swellings of the first arches increase in size, at first fuse with the tuberculum impar, then grow more rapidly and outstrip it Simultaneously, there is a "slipping forward" of the entire mucosa of the tongue During this time, the tuberculum impar is fixed at the foramen cecum (and perhaps drawn caudad by the caudad proceeding thyroid) while it is tend-

ing to be overgrown anteriorly and laterally and overlapped posteriorly Because of the eventual V shape of the sulcus terminalis, there seems to have been fixation of the central portion of the root as well (Fig 3)

Consequently, the tuberculum impar does not normally appear in the human adult tongue, but if any of the factors tending to cause its disappearance were deficient or if it were reactivated by some metabolic or nutritional stimulus, a persistent tuberculum impar could result It might persist in its most perfect form—a rhomboid area in the midline of the posterior dorsum of the tongue—but it could be anteriorly or laterally displaced, and of any shape It could be split (Fig 2) and appear in either two or three segments It could appear in some form anywhere in the tongue except *posterior to the foramen cecum and the sulcus terminalis* This persistence might be frank and on the surface or veiled by a superficial covering of the usual lingual mucosa

Loos and Horbst have come to the same conclusion as to the origin of the process, but classify it as belonging in the group of the vascular nevi, a classification which, in our opinion, is not well supported by histologic findings It would seem to us that the tuberculum impar, whenever it has made an appearance, has simply demonstrated its kinship with the unpapillated, lymphocyte infiltrated base of the tongue rather than with the papillae bearing apex Under these conditions, glossitis rhombica mediana is more logically classified as an anomaly rather than as a disease

Symptoms and Clinical Findings—In general, the process is of long duration and is usually attended by no subjective symptoms Ten of our cases were referred to us with lesions discovered accidentally and only one complained of vague discomfort Of Brocq and Pautrier's 17 cases, one complained of slight pain on mastication, and one of a localized burning sensation In May's case, there was slight interference with the movements of the tongue The duration in most of our patients was short (three weeks to ten months), but we believe that if it were not for modern dental care and clinic facilities, many of these cases would have gone for years without remark Brocq and Pautrier reported a case of seven years' duration, and Loos and Horbst one of about 30 years' duration

The typical lesion, as we have observed it, is a nonulcerated rhomboid or ovoid mass or plaque situated in the midline of the dorsum of the tongue just anterior to the apex of the V formed by the circumvallate papillae (Figs 4 and 5) The mass or plaque usually extends forward for a distance of 2 to 3 cm, but is always sharply limited posteriorly by the sulcus terminalis The surface of the lesion may be only slightly raised with borders which merge gradually into the normal level of the surrounding mucosa In other instances, the lesion may be raised as much as 4 to 5 Mm, with its edges arising rather abruptly from the tongue surface In most instances, the involved area presents a definite difference in color and an absence of the normal papillary, furred character of the mucosa of this portion of the tongue The change in the color and surface texture of the mucosa is usually rather abrupt and may

extend several millimeters beyond the raised portions of the lesion The surface may be smooth and glistening or occasionally slightly fissured and mammillated There is no surface ulceration, but more or less induration is always present Pain and tenderness are characteristically absent The size and extent of the lesion, even though untreated and of long standing, is self limited to about 1½×3 cm

DIAGNOSIS —Unless one is familiar with both diseases, glossitis rhombica mediana is quite apt to be confused with cancer of the tongue Such characteristics as chronicity, absence of subjective symptoms, induration and apparent infiltration of the surface are common to both diseases In our opinion, a clinical diagnosis of glossitis rhombica mediana should be made from the

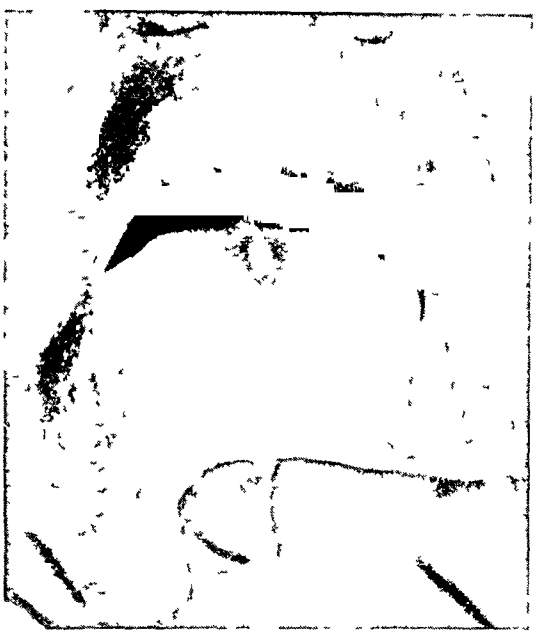


FIG 4 —Photograph of Case 2 showing the typical midline situation of the growth in instances of glossitis rhombica mediana

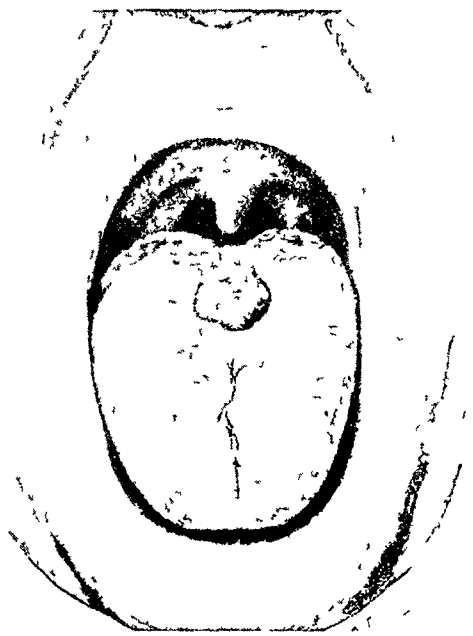


FIG 5 —Drawing of the lesion in Case 11 showing more in detail the position and general gross characteristics of the growth

unique position of the lesion—*directly in the midline of the tongue just anterior to the V line of the circumvallate papillae* This area of the tongue is singularly free from *primary* cancer, although it may of course be invaded by extension from adjacent areas

So far as we know, there is no instance of a malignant growth arising primarily in this area in about 2,000 cases of tongue cancer in the records of the Memorial Hospital Cancer of the tongue characteristically arises in the lateral borders, the tip and at the base, posterior to the sulcus terminalis Occasionally, growths arise on the dorsum of the anterior half, but never in the rhomboid area, to our knowledge The same regional incidence also may be used to differentiate two other fairly common chronic lesions of the tongue namely, gumma and tuberculous ulcers, which in our experience, are not found to arise in the rhomboid area In our opinion, the diagnosis of glossitis rhom-

bica mediana may be made safely on the clinical features alone without biopsy The unique position of this lesion in the midline of the rhomboid area of the tongue is its most significant diagnostic feature Biopsy does no particular harm, but in our opinion, is unnecessary except for purposes of record

MORBID ANATOMY AND HISTOLOGIC FINDINGS —The lesion is quite sharply delimited in its borders and tends to involve only the mucous and submucous tissues whose thickness is increased to a variable degree There is little or no tendency toward deep infiltration or invasion of the muscular body of the tongue, from which the mass is quite readily separated by surgical excision

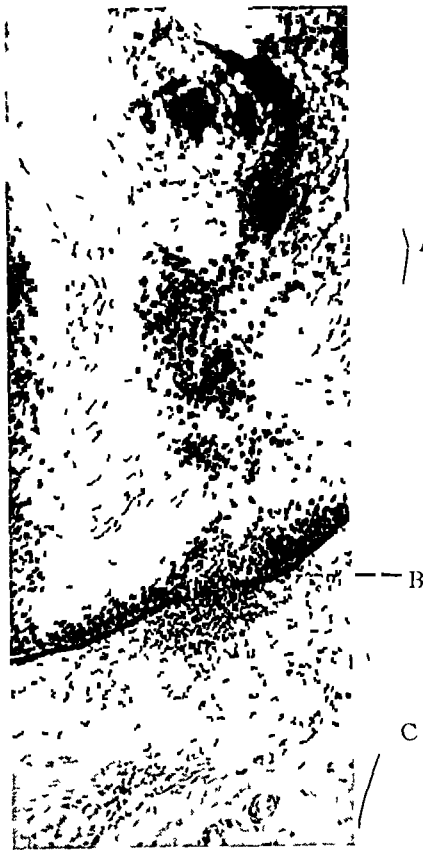


FIG 6 —Case 5 Photomicrograph showing (A) Hypertrophy hornification and desquamation of epithelium (B) Nodular mass of lymphocytes invading epithelium (C) Subepithelial fibrosis and numerous plasma cells (high power)

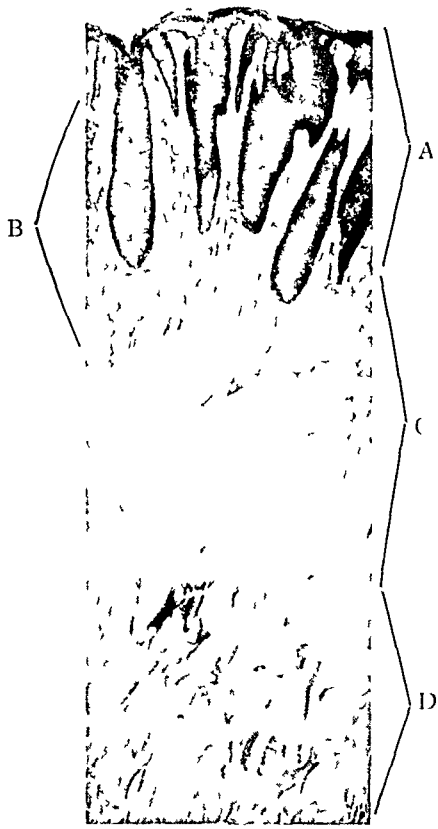


FIG 7 —Photomicrograph showing (A) Epithelial hypertrophy and downgrowth (B) Lymphocytic infiltration of subepithelial and epithelial tissues (C) Subepithelial fibrosis and edema (D) Atrophy and degeneration of muscle fibers (low power)

The histologic findings are not uniform There is usually a variable degree of hypertrophy of the epithelium with a tendency toward plexiform downgrowth of well differentiated cells, and occasionally, orderly pearl formation The surface layers are hornified and desquamating, and while well developed fissuring is common, there may be only slight indenting of the surface cells

A common finding is a diffuse lymphocytic infiltration of the subepithelial

tissues Plasma cells may also appear and occasionally are a conspicuous feature (Case 5) Nodular masses of lymphocytes are commonly found just below the tips of the down-growing epithelial pegs, and in a few instances, such nodular masses have disrupted the basal layer of the epithelium and lie half in the subepithelial tissue and half in the epithelial tissue Rarely, nodular masses appear entirely within the epithelial layer (Fig 6)

There is almost always a considerable degree of fibrosis in the subepithelial tissues which may extend down to, and occasionally into, the muscle layer When the latter condition occurs, the adjacent muscle fibers are atrophied or show marked hyaline degeneration and edema The blood capillaries and the lymphatics are dilated and new capillaries may be seen in the process of formation Occasional thrombi appear in the most superficial capillaries (Figs 7 and 8)

We have found no evidence of malignant degeneration in any of the specimens examined in our laboratory The epithelial growth is quite exuberant, but not disorderly, and the cells themselves are normal The morphology and histology, as described in previous reports, are about the same as ours



FIG 8 —Case 5 Photomicrograph showing a higher power detail of Fig 7, particularly the diffuse lymphocytic infiltration of subepithelial tissue There is a tendency toward grouping of lymphocytes at the tips of the epithelial pegs and invasion of the epithelium by lymphocytes at these points

CASE REPORTS

Case 1 —F T, white, male, age 37, was admitted in June, 1932 Two months previously, he had noted on his tongue a small, painless "ulcer," which had gradually increased in size He was a "heavy smoker"

Examination revealed in the midline of the dorsum of the tongue, anterior to the circumvallate papillae, a deep red area measuring 1½×1 cm In the center of this area was a nonulcerated, raised nodule less than 1 cm in diameter The lesion was slightly indurated The remainder of the tongue was "coated" There was moderate dental sepsis, but no leukoplakia The blood Wassermann reaction was negative

Treatment and Clinical Course —The lesion proved unresponsive to heavy doses of potassium iodide, and was excised by the endotherm knife in October, 1932 The wound healed by secondary intention The patient was last seen in February, 1936, at which time there was no evidence of recurrence

Case 2 —W M, white, male, age 39, was admitted in January, 1933 Two and one-half years previously, he had been informed by his dentist of the presence of a lesion

on his tongue It was symptomless and had not increased in size He was a moderate pipe smoker

Examination revealed in the midline of the dorsum of the tongue, just anterior to the circumvallate papillae, a raised, irregular, nonulcerated lesion measuring 1½ cm in its longest diameter (Fig 4) There was moderate associated glossitis, but no leukoplakia The blood Wassermann reaction was negative

Treatment and Clinical Course—The lesion was removed by surgical excision in February, 1933, healing by primary union The patient was last seen in August, 1936, at which time there was no recurrence

Case 3—V S, white, male, age 35, was first seen in December, 1934 Five months previously, during a tonsillectomy, a "tumor" was removed from the dorsum of the tongue He was referred to the Memorial Hospital with a diagnosis of "epithelioma" The patient smoked about 20 cigarettes daily

Examination revealed in the midline of the dorsum of the tongue, posteriorly, a ridge like, pinkish, nonulcerated lesion 3 cm in its longest diameter To the left of this was a small, superficial, whitish slightly indurated area with the appearance of a superficial abscess The mucosa of the entire tongue was hypertrophied There was moderate dental sepsis, but no leukoplakia The blood Wassermann and Kahn tests were negative

Treatment and Clinical Course—No active treatment was given in our clinic, and he was last seen in May, 1935, at which time there was no apparent change in the lesion He has failed his subsequent appointments

Case 4—O M, white, male, age 57, was first seen in May, 1935 Two months previously, a small circular plaque appeared on the dorsum of the tongue It caused no discomfort and had not increased in size He stated that he had smoked about 30 cigarettes daily for some years

Examination revealed, in the midline of the dorsum of the tongue, just anterior to the vallate papillae, a raised, pinkish, slightly indurated, rectangular patch The surrounding mucosa presented a furred yellowish appearance There was moderate dental sepsis, but no leukoplakia The blood Wassermann and Kahn tests were negative

Treatment and Clinical Course—He was followed at intervals until August, 1935, without any apparent change in the lesion, but has failed his subsequent appointments

Case 5—J R, white, male, age 42, was first seen in September, 1935 Five months previously, he had noted a reddish spot in the center of his tongue It was symptomless, but during the preceding month had slowly increased in size He admitted being a moderate smoker

Examination revealed, in the midline of the posterior third of the dorsum of the tongue, a slightly raised, pinkish area, measuring 2 cm in its longest diameter Its borders were ill defined and irregular The surrounding mucosa was pale yellow Intraoral hygiene was fair, and there was no leukoplakia The Kahn test was negative

Treatment and Clinical Course—In September, 1935 a total of eight millicuries in four gold filtered radon seeds were implanted in the lesion Regression was incomplete, and, in November, 1935, the lesion was surgically excised He was last seen in September, 1936, at which time there was no evidence of the original disease

Case 6—I S, white, male, age 49, was admitted in October, 1935 Three weeks previously, he had noticed a pinkish area on the dorsum of his tongue There were no subjective symptoms He had smoked about 40 cigarettes daily for several years

Examination revealed, in the midline of the dorsum of the tongue, just anterior to the circumvallate papillae, an ovoid, pinkish, smooth area with slight thickening of the mucosa at the center The surrounding mucosa was thickly coated The Wassermann reaction was negative

Treatment and Clinical Course—He was advised to stop smoking and as to the proper procedures to improve oral hygiene He was last seen in August, 1936, when there was some improvement in the general oral hygiene, but there still remained one small area of residual glossitis

Case 7—B K, white, male, age 43, was first seen in December, 1935 Two months previously, because of an "uncomfortable" feeling in his tongue, he consulted his own physician who referred him to Memorial Hospital for diagnosis and treatment At no time had there been actual pain in the tongue He smoked about 15 cigarettes daily

Examination revealed, in the midline of the dorsum of the posterior third of the tongue, a reddened area, measuring 2×1½ cm, over which the epithelium was smooth and glistening There was slight resistance at the center of this area, but true induration was not present The blood Wassermann reaction was negative

Treatment and Clinical Course—He was not seen again until March, 1936, at which time marked regression was noted No treatment of any kind had been given In April, 1936, the tongue was fairly normal in appearance He was last seen in October, 1936, with no recurrence

Case 8—C L, white, female, age 46, was first seen in June, 1936 Ten months previously, she had noted a "spot" in the center of her tongue which looked like a collection of "white pimples" A little later she noted a burning sensation in this region and the area became red and roughened Three months previously a biopsy had been made and reported as "squamous carcinoma" Some radium treatment had been given There was no history of smoking

Examination revealed, in the midline of the dorsum of the tongue just anterior to the circumvallate papillae, an oval, smooth, deep red, moderately indurated area 2½×2 cm in extent and slightly raised above the surface of the tongue Over the surface of the lesion, the papillae were atrophied and there was an absence of the furring present over the remaining surface of the tongue There was no marked dental sepsis The histologic slides were obtained and reviewed and no evidence of cancer was found The patient was referred back to her private physician without treatment

Case 9—A S, white, male, age 40, was referred to Memorial Hospital in September, 1932, because of hoarseness He was not aware of any abnormality of the tongue He had smoked 15 to 20 cigarettes a day for many years After examination of the larynx, a diagnosis of pachydermia of the vocal cords was made, and he was observed at intervals of about three months until September, 1936, when during the examination of his larynx, the examining physician noted an ovoid, sharply demarcated, pinkish area in the midline of the dorsum of the tongue just anterior to the circumvallate papillae Its size was about 1½×3 cm The lesion was slightly raised and slightly indurated, and in its anterior aspects there were a few shallow transverse fissures There was complete edentation and no glossitis

Treatment and Clinical Course—No treatment was given The patient returned again in March, 1937, for examination of his larynx, at which time no change was noted in the appearance of the tongue lesion, and although the patient was aware of it, he stated that it produced no symptoms

Case 10—G H, white, male, age 50, was seen in consultation in March, 1937 About ten months previously, he had first noted an area on the midline of the dorsum of the tongue which appeared to be of a different color from the rest of the tongue surface He was a moderate smoker There were no subjective symptoms The patient stated that it was not raised above the surface at the beginning, but that later a slight elevation occurred About nine months after the first appearance of the above mentioned lesion, he consulted a physician for an unrelated complaint and spoke to him about the tongue This physician referred him to a surgeon who took a biopsy and treated him by the insertion of radon seeds An acute localized radiation reaction occurred which regressed without causing any appreciable change in the appearance or character of the lesion

Examination revealed, in the midline of the dorsum of the tongue in the rhomboid area, a pinkish red area, ovoid in shape, which lacked the furred appearance of the remainder of the tongue The lesion was slightly raised and nodular and presented one

transverse fissure, but no ulceration The histologic slide was obtained for review and the findings were typical of those observed in glossitis rhombica mediana

Treatment and Clinical Course—He was referred back to his physician without treatment

Case 11—L S, white, female, age 44, was first seen in February, 1937 Three and one-half months previously, a "pimple" the size of a pea had appeared on the dorsum of the tongue and had grown slowly At first she had experienced a sense of irritation in this region, but later all abnormal sensations had disappeared

Examination revealed, in the midline of the dorsum of the tongue, just anterior to the line of the circumvallate papillae, a pale, pinkish, raised, lobulated, nonulcerated, slightly indurated lesion measuring 1½×1 cm and elevated about 4 Mm above the surrounding mucosa (Fig 5) The anterior third of the lesion was covered by normal mucosa, but in the posterior portion, the mucosa was smooth and glistening The mucosa of the remainder of the tongue was normal in appearance There was moderate dental sepsis The blood Wassermann and Kahn tests were negative No treatment was given and she was directed to return for interval observation

TREATMENT—No treatment is indicated except in patients with marked cancerphobia where mental relief is to be obtained only with disappearance of the tumor In such instances surgical excision is the method of choice The lesion may be removed under local anesthesia by an elliptical incision just wide enough to completely include the margins and carried down to the musculature of the tongue The necessary depth of excision can be accurately gauged by the palpable induration The incision is closed by interrupted sutures to be removed on the fifth or sixth postoperative day In our experience, and as one might expect from the histologic findings, the lesions have exhibited about the same response to radiation as the adjacent normal tissues Three of our present series and several earlier cases (not included in this series because of insufficient clinical data) were irradiated without benefit Electrodesiccation or the endothermic knife has been recommended by some authors, but these methods prolong convalescence unnecessarily, since they leave an open wound to heal Surgical excision with immediate suture was used in a few of our cases to relieve marked cancerphobia and to obtain histologic material

SUMMARY AND CONCLUSIONS

Glossitis rhombica mediana is not a malignant process It may be differentiated from cancer of the tongue by its typical shape and location, and biopsy should not be necessary for diagnosis The lesion is probably not of inflammatory or irritative origin We believe that it may be of embryonal origin and that it may represent a belated appearance of that portion of the tongue derived from the tuberculum impar No treatment is indicated, but, if because of cancerphobia the individual patient demands removal of the lesion, surgical excision is the method of choice

REFERENCES

[1] Brocq, L, and Pautrier, L M Glossite losangique mediane de la face dorsale de la langue Ann de dermat et syph, 5, 1, 1914

[2] Arndt (Case report) Zentralbl f Haut u Geschlechtskr, 3, 341, 1922
[3] Fordyce, J H, and Cannon, A B A Hitherto Undescribed Condition of the Tongue Arch de dermat et syph, 8, 749, 1923
[4] Lane, J E Glossitis Rhombica Mediana Arch de dermat et syph, 9, 547, 1924
[5] Zimmerman, L Etiology and Diagnosis of Brocq's Glossitis Rhombica Mediana Dermat Ztschr, 54, 168, 1929
[6] Abshier, A B Glossitis Rhombica Mediana, Report of Case with Results of Treatment Arch Dermat and Syph, 30, 409, 1934
[7] Loos, H O, and Horbst, L Nature of Glossitis Rhombica Mediana Arch f Ohren-, Nasen-, und Kehlkopfh, 138, 122, 1934
[8] Gougerot, H, and Dechaume, M Critical Study of Smooth Syphilitic Plaques, Differentiation of Smooth Non-syphilitic Plaques, Atypical Forms of Lozenge-like Median Glossitis Ann d mal ven, 28, 801, 1934
[9] Spencer, W G, and Cade, S Diseases of the Tongue 3rd ed Philadelphia, Blakiston's Son and Co, 1931
[10] Butlin, H T Diseases of the Tongue 2nd ed London, Cassell and Co, 1900
[11] Blair, V P Surgery and Diseases of the Mouth and Jaws 2nd ed St Louis, C V Mosby Co, 1916
[12] Dubreuilh, W Glossite mediane de la face dorsale de la langue Ann de dermat et syph, 5, 615, 1914–1915
[13] May, J Glossite losangica mediana An facultad de med (Montevideo), 7, 219, 1922
[14] Arey, L B Developmental Anatomy 3rd ed Philadelphia, Saunders & Co, 1934

PLASTIC RECONSTRUCTION OF THE ESOPHAGUS*

CARL EGGERS, M D
NEW YORK, N Y

THIS operation has to be considered chiefly in patients with an impermeable stricture in whom the prospect of a permanent gastrostomy furnishes sufficient indication to warrant such a serious and difficult procedure It may also be considered in cases of resection of the esophagus for any reason At the present time such an indication is rarely presented, but when resection of the esophagus for carcinoma becomes a more common procedure, a wider field will be opened up

The first attempts at reconstruction seem to have been made by E Bircher, in 1894 He constructed a skin tube of the thoracic wall and united it with the esophagus stump above and the gastrostomy opening below Both his cases died The method was also used by Payr, Lexer, Kuttner and Frangenheim, all of whom found difficulty resulting from the development of fistulae These occurred at the junction of the skin tube and the gastrostomy and were due to ulcer formation caused by digestion of the skin tube by gastric juice Wullstein proposed a plastic procedure which utilized a loop of jejunum below, with a skin tube connecting with the esophagus above

One of the best known methods is that originally proposed by Roux, who completely mobilized a long loop of jejunum, and after reestablishing continuity of the gut, implanted the lower end into the anterior wall of the stomach, while its upper end was drawn through a subcutaneous channel on the anterior chest wall and united with the esophagus stump Numerous authors used this procedure, but most of the cases resulted in failure

Lexer combined the two methods by using a much shorter loop of jejunum for the lower esophagus, and forming the upper portion from a skin tube as suggested by Bircher This method has found many supporters and a considerable series of successful cases has been reported One such case was operated upon by Frangenheim in 1921, and is reported by Haberland, formerly an assistant of Frangenheim, in the 1936 Archiv fur Klinische Chirurgie, which cites the present condition of a patient 15 years after the esophagoplasty He has grown to be a healthy young man, able to eat and swallow everything There are included in the article numerous photographs and roentgenograms of the patient illustrating the peristaltic action of the new esophagus Another similar case was reported by Alton Ochsner and Neal Owens before the American Surgical Association, in 1934 (ref ANNALS OF SURGERY, 100, 1055, 1934)

Besides skin of the chest wall and small intestine, the transverse colon has

* Read before the New York Surgical Society, February 10, 1937 Submitted for publication April 16, 1937

also been used for plastic reconstruction of the esophagus Similar methods of procedure were proposed independently by Kelling and Vulliet Successful results were reported by V Hacker and Schlagenhaufer A very interesting method is the construction of an esophagus tube from the wall of the stomach It was originally proposed by M Hirsch, and the names of Jianu and Halpern are connected with the further development of this procedure Finally there is the total transplantation of the stomach under the skin of the anterior chest wall with insertion of the esophagus stump into the fundus of the stomach, as proposed by Kirschner All these different methods are ingenious, and require a great deal of patience and perseverance on the part of the patient as well as the surgeon

Case Report—A McK, male, age 50, had a resection of the thoracic portion accomplished three years ago for stenosis of the esophagus A gastrostomy had been performed previously The clinical diagnosis was carcinoma, but the biopsy was negative The procedure employed was that described by Doctor Torek The patient made a good recovery, and was able to manage quite well with the aid of a rubber esophagus which connected his esophagus stump with the gastrostomy (Fig 1)

He was presented in that condition before the New York Surgical Society May 9, 1934, and the case report was in the ANNALS OF SURGERY, 101, 940, March, 1935 He was also cited in a discussion of Doctor Ochsner's case of esophagoplasty before the American Surgical Association (ref ANNALS OF SURGERY, 100, 1055, 1934)

The patient became anxious to discard the tube in order to be able to work and to eat in restaurants The various plastic procedures were therefore reviewed and it was decided to construct an esophagus from the skin of the chest wall This method seemed to offer the simplest solution, especially if one considered that any intra-abdominal operation might be difficult on account of adhesions resulting from a previous perforation of a duodenal ulcer and the presence of a gastrostomy The procedure was to be divided into stages as follows (1) Construction of a skin tube (2) Closure of the upper end by joining the esophagus stump with the skin tube (3) Closure of the lower end by joining the skin tube with the gastrostomy

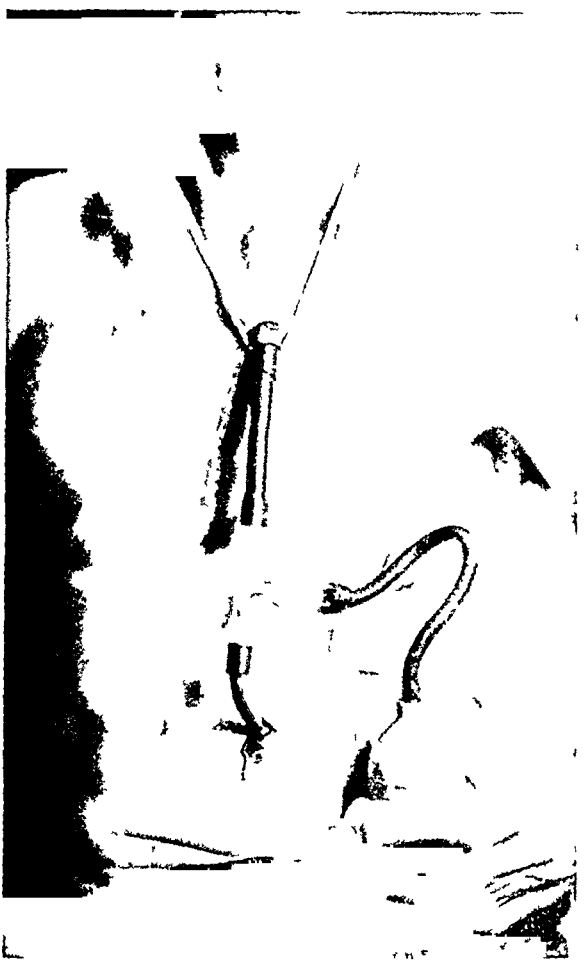


FIG 1—Photograph illustrating the rubber esophagus connecting the upper esophagus stump with the gastrostomy The interposed rubber bulb is used to facilitate the passage of food downward

The first stage was carried out May 16, 1935 Two perpendicular incisions were made over the left anterior part of the chest, outlining a three-inch strip of skin extending from the esophageal opening to the gastrostomy The skin edges were now care-

fully undermined and by rolling them toward the midline they could be approximated with interrupted plain catgut sutures to establish a complete, skin lined tube ten inches long The superficial fascia of the flap was now likewise approximated with interrupted plain catgut to reinforce the skin suture line All sutures approximating the skin edges were so placed that they emerged at the skin margin without penetrating the skin itself Above, construction of the skin tube was carried beyond the esophageal opening in order to have a funnel which would catch all saliva coming out of the opening, and

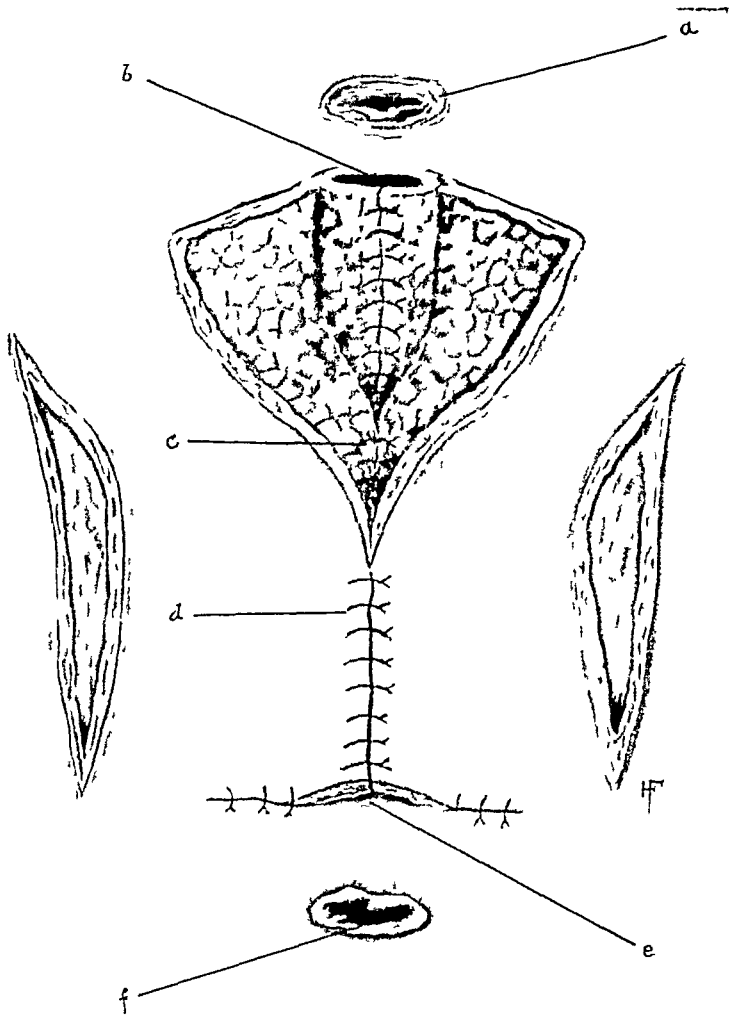


Fig 2—Drawing illustrating the formation of a ten inch subcutaneous skin tube to serve as a new esophagus (*a*) Esophagus stump (*b*) Upper end of new esophagus (*c*) Suture of superficial fascia of skin tube (*d*) Completed esophagus from skin of chest wall (*e*) Lower end of new esophagus (*f*) Gastrostomy opening

to carry it downward Below, however, the tube was constructed only to just above the gastrostomy in order to permit free access to it (Fig 2)

The lateral skin margins were now undermined and thoroughly mobilized as far as the axilla on both sides This permitted approximation over the newly formed skin tube in the upper two-thirds without undue tension Below, however, it was necessary to make counter incisions to relax the tension The releasing incisions were not covered with grafts, but allowed to granulate They were used temporarily for drainage, in order to prevent stagnation of secretion under the large mobilized skin flaps Other drains were

placed at points of vantage and a large dry dressing applied The patient withstood the operation well, and primary union, without any disturbance of healing, resulted in the entire ten inch tube as well as in its covering

A month later, June 17, 1935, the upper end of the anstomosis was completed The deep closure was quite simple, but there was so much tension on the edges of the undermined skin which was used to cover it, that subsequent separation was feared However, only partial separation resulted, and the defect was later closed with a small pedunculated flap obtained from the adjacent skin



FIG 3 —Roentgenogram demonstrating the function of new "skin tube' esophagus Food passes down very rapidly by gravity plus muscular contraction of pharynx and esophagus stump

There remains, then, the third step in the complete operation namely, the anastomosis between the lower end of the skin tube and the gastrostomy No doubt it could be carried out by the same procedure used at the upper end However, the patient is reluctant to have this done, and after studying all the facts in the case, as well as the available literature, I agree with him Ochsner states that of 32 patients who were operated upon by this method, 21 recovered, but that in 18 instances there was fistula formation at the

lower end These fistulae, due to ulcer formation and digestion of the skin tube by regurgitated gastric juice, have been a source of great annoyance to nearly all patients In spite of the fact that our patient has a Janeway gastrostomy, which insures against free leakage, he has had regurgitation with irritation and painful superficial ulceration It is for this reason he prefers to leave conditions as they are

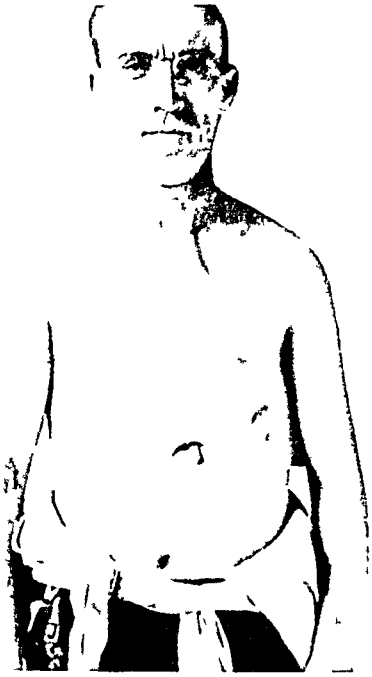


FIG 4 —Photograph showing the final result Complete reconstruction of the esophagus except at its lower end where the skin tube connects with the gastrostomy

The patient has constructed for himself a small tube, bent like a knee, one end of which fits snugly into the lower end of the skin tube, the other into the gastrostomy There is no leakage at all He is able to eat everything, and does not require an unusual quantity of fluid to wash down solid foods He is able to eat in restaurants At night he removes the tube, and then swallows water in order to wash out the esophagus to prevent fermentation There has at no time been any irritation

A recent roentgenologic study has shown excellent function (Fig 3) It has not been determined to what degree gravity plays a role in the propulsion of food The impression one gets is that the contraction of the pharyngeal muscles alone is sufficiently powerful to squirt food through the skin lined tube ten inches in length As a matter of fact, food passes down so rapidly that it was not possible for Doctor Stewart to take a moving picture of the process

The patient is well (Fig 4) He has gained 50 pounds since the time of his esophageal obstruction Any further operative intervention is hardly justified, but should one consider it, the transplantation of a short loop of jejunum reaching from the stomach to the lower end of the skin tube would be the method of choice

DISCUSSION —DR JOHN B FLICK (Philadelphia) called attention to the fact that in most clinics carcinoma of the esophagus tends to resist treatment by various means despite the development of exact methods of diagnosis and the refinement of surgical technic Theoretically, however, malignant lesions of the esophagus can be diagnosed early and should be curable by surgical removal of the lesion in selected cases No other method of treatment at present offers any prospect of cure One reason for the infrequent cure of cancer of the esophagus by the surgeon is the neglect of the patient, and also of the practitioner, to investigate early, vague symptoms of disturbance in swallowing For a long time cancer of the esophagus is a purely local process

DR FRANZ TOREK (New York) expressed his pleasure in the fact that the demonstration of Doctor Eggers' results brought out the fact that there must be thorough exposure, an underlying principle without which success cannot be obtained Carcinoma can be treated successfully only by radical removal If radium were capable of treating the carcinoma without doing other damage, it might be a very good form of therapy It is not sufficient, in surgery, to remove the carcinoma alone, a certain amount of supposedly healthy tissue must also be removed

INFLAMMATORY TUMORS OF THE GASTRO-INTESTINAL TRACT*

GUILFORD S DUDLEY, M D , AND LAURENCE MISCALL, M D
NEW YORK, N Y

THE not uncommon confusion of the so-called inflammatory tumors of the gastro-intestinal tract with malignant and other diseases and the poor results which may follow failure to make this differential diagnosis warrants a review of the subject

The terms, inflammatory tumor, infective granuloma,[13] non-specific granuloma,[11] chronic cicatrizing enteritis,[18] regional ileitis,[17] and others, are all synonymous They infer a type of chronic productive inflammatory reaction to infection with a tendency to the formation of a tumor or mass Thus, they should be sharply differentiated from the specific granulomata of tuberculosis, lues, actinomycosis, *etc*

A fairly thorough review of the literature yields a vast amount of varied information both factual and conjectural in character Since recognition of the more widely accepted facts will probably lead to better diagnosis and treatment, it seems preferable to outline them rather than discuss many of the points still remaining controversial

Ninety years ago Virchow,[1] discussing chronic peritonitis, described the formation of flat or villous-like thickenings on the peritoneum either single or multiple He had observed their occurrence in the region of the appendix, hepatic, splenic, and sigmoid flexures of the colon In some instances partial narrowing of the lumen with constriction was present It was his impression that this peritonitis resulted from any inflammation of the intestinal wall by direct continuation or from other abdominal organs

The problem lay practically dormant in the literature until Moynihan,[2] in 1906, read a paper entitled, "The Mimicry of Malignant Disease in the Large Intestine," in which, he reported six cases with a mistaken preoperative diagnosis of malignant disease Four of these were diagnosed as consisting of chronic inflammatory tissue from various causes He stated that "The inflammatory tumors of the large intestine, excluding the tuberculous conditions, are, it would appear, far more frequent than we have supposed The exact nature of the conditions present are not always the same The inflammation may begin in and penetrate the mucosa, a false diverticulum may form and may perforate, extensive undermining ulceration may be combined with a form of polypoid growth or, finally, the inflammatory deposit may affect the peritoneal coat, chiefly or solely, leaving the mucosa

* Read before the New York Surgical Society, November 25, 1936 Submitted for publication March 4, 1937

supple and intact" While offering no etiologic classification, he emphasized the mimicry of malignant disease

In 1908, A W Mayo-Robson[3] detailed the record of 11 abdominal cases in which he had failed to differentiate inflammatory from malignant disease His errors had occurred, once in the esophagus, four times in the stomach, once each in the small intestine, cecum, ascending colon, transverse colon and splenic flexure, and twice in the rectum He related the satisfactory and frequently surprising results which he had obtained with short circuiting operations in some of these cases which had been diagnosed hopelessly incurable cancer In view of this experience, he recommended exploration of all doubtful cases Although he could offer no definite etiology, he clearly separated this group from the specific granulomata

In 1909, Heinrich Braun[4] reviewed the literature and, adding two cases, was the first to describe in detail the gross and microscopic pathologic pictures He definitely set this apart from the specific granulomata In 1911, Giffin[5] reported an inflammatory mass around a diverticulum of the rectum and observed the possibility of fistula formation Between 1907 and 1917, Proust and Lejars,[6] Hamann,[7] and Lee[8] each added case reports Lee's case illustrated the possibility of abscess formation in this disease In 1912, McGrath,[9] having found chronic extramucosal inflammation with mass formation in 27 cases of symptomatic diverticula of the large bowel, quoted Telling [10] "Of all the secondary results this proliferative inflammation is the most important, the most frequent and probably the most overlooked" He cautioned against the hasty labeling of colonic masses as malignant disease He attributed the lack of luminal intestinal symptoms (bloody and purulent stools, *etc*) to the relative freedom of the mucosa from involvement and stated that careful handling of such inflammatory masses may avert adhesions, fistulae, abscesses, peritonitis and death

Thus, to this time, attention had been directed to the presence of these tumors frequently closely resembling malignant disease, both clinically and pathologically, to their inflammatory nature as distinct from tuberculosis, lues and actinomycosis, to the danger of intraperitoneal infection and to the production of strictures or fistulae in the course of the disease The lesions had occurred in both the large and small intestines, stomach and esophagus, with the only ascribable causes mentioned being foreign bodies, ulcers and diverticula

It was not until Moschowitz and Wilensky,[11] in 1923, reported four cases under the caption of "Non-specific Granulomata of the Intestines" that the surgical profession in this country showed real interest in the subject Although recognizing the etiologic importance of foreign bodies and diverticula, they believed that the cause was usually unknown and felt that the erroneous diagnosis of hyperplastic tuberculosis concealed many instances of this disease They noted that after sidetracking operations, the tumors frequently tended to disappear Without doubt, their paper is responsible for the present increase in the recognition of the disease

In 1928, Barron,[12] studying the occurrence of simple, nonspecific ulcers from esophagus to anus (ulcers other than those due to tuberculosis, lues, dysentery, typhoid fever, parasites and malignant disease) mentions them as another possible and difficultly recognized cause of this type of inflammation, especially in the colon In 1931, Mock[13] ventured the opinion that decreased blood supply and trauma may be etiologic factors in some cases His advice to remove a section for biopsy in all apparently inoperable intestinal tumors should be accepted guardedly, since such procedure may excite serious sequelae In 1932, Wilensky[14] summarized his attitude toward the problem by stating "Non-specific granuloma of the intestinal tract offers no characteristic clinical concept because the etiology, symptoms and signs are protean and indefinable" In 1932, Raiford[15] classified the nonspecific granulomata of the gastro-intestinal tract as one of the lymphoblastomata, and emphasized the occasional difficulty of accurate pathologic diagnosis In 1933, Erdmann and Burt[16] suggested that the process may originate in an injury to the mucosa with subsequent ingress of infection of a low-grade type In 1932, Crohn, Ginzburg and Oppenheimer[17] introduced the term, "regional ileitis" They believed that the terminal ileum is involved selectively enough to constitute a new clinical entity Their observation of the growth of a granuloma at the site of previous strangulation of intestine supports Mock's contention that the process may be initiated by an impaired blood supply In 1933, Harris, Bell and Brunn[18] suggested the name, "chronic cicatrizing enteritis," based upon their belief that the process occurs throughout the small intestinal tract This review indicates the rather wide acceptance of many facts

Pathologically, the inflammatory tumor may be described as a chronic, productive, inflammatory reaction to various etiologic factors and may often involve all the coats of the gut Early, it resembles chronically infected granulation tissue with many new blood vessels infiltrated by lymphoid and polymorphonuclear cells Giant cells of the foreign body type are not infrequently found Fibroblastic elements soon appear in the reaction which may now progress in several ways It may persist as a productive inflammation and, with progressively diminishing blood supply, may eventuate in adhesive peritonitis or fistula formation, or by suppuration in abscess formation or peritonitis Fibroblastic predominance may result in a dense stenosing cicatrix The small intestine, particularly the ileum, shows mucosal ulceration and cicatrization somewhat more often than the rest of the gastro-intestinal tract It should be emphasized that any part of the gastro-intestinal tract may be affected even though in the 51 cases reviewed, 26, or 51 per cent, occurred in the ileocecal region with six in the cecum, 13 in the cecum and ileum together and seven in the ileum alone Excepting the younger age incidence in the ileum most cases have been reported in the cancer age group (40 to 60)

Grossly, the lesion is most often confused with malignant disease in

the large bowel and stomach, and with either malignant disease or tuberculosis in the small bowel and cecum

The known causes may be grouped as either intra- or extra-intestinal From within the gastro-intestinal tract diverticula, foreign bodies, non-specific ulcers, colitis and polypi represent the major causes From without the gastro-intestinal tract foreign bodies, progression from other foci, and embarrassed blood supply are the important known factors However, in addition, a large number of cases remain without any indication of the actual origin The importance of these factors varies with the portion of the tract affected In most of the cases involving the stomach, an ulcer has accounted for the reaction Cases involving either or both the ileum and cecum have usually shown no more definite cause than the occasional presence of a foreign body or embarrassed blood supply Especially in the ileum does the question of etiology remain uncertain However, it may be suggested that the marked amount of lymphoid tissue in this area may be contributory to ulceration, thus possibly initiating the disease here The large intestine exhibits diverticula and foreign bodies as primary factors

The multiplicity and diversity of symptoms and signs preclude any great degree of accuracy in preoperative diagnosis Some points, however, deserve emphasis as possible aids Long standing indefinite symptoms such as a low grade of fever, anorexia, nausea and abdominal pain may suggest subacute or chronic disease of the gastro-intestinal tract

The pathologic stage of the disease gives rise to wide variation in the clinical picture The stage of infection may be ushered in as an enteritis or a colitis, adhesive peritonitis, diverticulitis, intra-abdominal abscess, visceral perforation or peritonitis Suffice it to state that usually the process remains of indolent nature and only rarely, as in sigmoid diverticulitis, progresses to an acute fulminating peritonitis The stage of intestinal obstruction is usually incomplete and may occur either before or after fibrotic stenosis of the bowel

Enumeration of the symptoms and signs of the above would entail a description of almost all intra-abdominal diagnoses Local tenderness, leukocytosis and a palpable mass may be present Further considerations in diagnosis must take into account the location of the disease The high percentage of error in preoperative diagnosis makes it essential to appraise, at the same time, the possibility of diagnosis at operation

The complaints of a young individual may have suggested duodenal ulcer which roentgenologic evidence of pyloric defect or obstruction may have corroborated Anemia may be present but the true cachexia of cancer is usually absent Palpation of a mass in the upper abdomen may readily throw the weight of evidence to malignant disease Inflammatory tumor must be thought of if the mass is larger, more tender and less hard than to be expected in the latter If at operation a large tumor of the stomach and duodenum with many inflammatory adhesions and without metastases in the liver be encountered, the diagnosis may be reasonably suspected Competent

observers have reported the presence of inflammatory tumors in the stomach and duodenum treated surgically as inoperable carcinoma Subsequent disappearance of these tumors has attested to their inflammatory nature

The occurrence of indefinite symptoms in the right lower quadrant may easily lead to error It is here that the inflammatory tumor is most common There may be a history of one or frequent attacks of enteritis, perhaps ulcerative in type with abdominal cramps, nausea and vomiting, slight fever and anemia At this stage the diagnosis is usually not made The mimicry of acute appendicitis is usually misleading but long duration of symptoms and anemia may arouse suspicion Many cases operated upon and dismissed as chronic appendicitis reveal the correct diagnosis with the subsequent development of a mass or intractable fistulae Direct trauma or strangulation of intestine in a hernia may antedate the onset of symptoms and the development of a mass A mass palpated before or at operation calls for differentiation from ileocecal tuberculosis, lymphosarcoma, carcinoma and benign tumors

The inflammatory tumor is usually not sharply limited in extent, may involve the ileum, cecum or both and is usually firm, with many adhesions The presence of fistulae, either viscerovisceral or external, either initial or postoperative, almost labels the disease Peri-intestinal abscesses are not uncommon Dense fibrosis of the ileum may exist The lesion may be multiple The absence of active, pulmonary tuberculosis almost rules out ileocecal tuberculosis Lymphosarcoma does not spread as widely, nor does it have the excess of inflammatory adhesions Carcinoma may be partially ruled out by the smaller area involved, the very hard consistency of the tumor, the presence of metastases and the lack of early adhesions Benign tumors should be recognized easily

It may be suggested that the use of roentgenologic studies with barium, in the presence of small intestinal obstruction, submits the patient to the possible precipitation of acute intestinal obstruction and should be used only with the greatest caution The factors mentioned above hold good for the entire small intestinal tract

If the symptoms are of colonic nature one must look for presumptive aids in the history such as colitis, nonspecific ulcers, foreign bodies and especially diverticula The inflammatory tumor does not develop the bloody stools, anemia and cachexia of right-sided colonic carcinoma nor the acute obstruction of left-sided colonic carcinoma A tender mass may be palpable and associated with leukocytosis, indicating infection Proctoscopy with biopsy and roentgenologic studies are useful At operation the inflammatory tumor is larger, more widespread, less hard and lacks the metastases of malignant disease Many inflammatory adhesions and small abscesses may be found

Surgical recommendations should be governed by several factors First, conservative surgery may, and frequently does, result in cure without the added risk of radical intervention Second, the ever present chance for

error should allow for the occasional necessity of further surgery Third, any surgical procedure meeting these standards and offering the opportunity of accurate diagnosis certainly has merit in itself

We believe that these criteria definitely favor the side-tracking operations as the best solution of the problem, at least, until more is known of the etiology and diagnosis of the disease The application in any part of the gastro-intestinal tract of this treatment seems to show sound basic advantages over the more radical procedures

If all findings do not label a gastric mass as malignant, a gastro-enterostomy and biopsy of the regional nodes should be performed This procedure may cure an inflammatory tumor and, if the biopsy is reported malignant, secondary resection may be completed with little loss to the patient Furthermore, resection for an inflammatory mass carries not only the higher risk inherent in the operation itself but also the added danger of severe infection and fatal peritonitis

In the ileocecal region conservative surgery offers a definite advantage A simple side-tracking operation, with biopsy of regional lymph nodes, permits of more accurate diagnosis and probably will cure the inflammatory tumor It will reduce the incidence of complications often following radical procedures Lymphosarcoma, notoriously, is not amenable to surgical cure Radiation therapy may be of some benefit Hyperplastic tuberculosis may be resected after the diagnosis has been proven Adenocarcinoma of the ileum may be secondarily resected even though these tumors metastasize and recur early

Surgery of the large bowel carries the risk of severe and fatal peritonitis calling for care and judgment in selection of the operative procedure Such procedure should be at least consistent with possible recovery Any abscess should be incised and drained only, even though it is known that fistulae may persist Simple removal of a foreign body may effect a cure Biopsy in this region, except for removing a regional lymph node, is inadvisable If the diagnosis of inflammatory tumor can be reasonably suspected, short circuiting types of operations certainly are desirable If practicable, colo-colostomy or enterocolostomy may be performed, if not, simple colostomy If the tumor is readily delivered outside the abdominal cavity a Mikulicz type of procedure may be carried out In the event of discovery that the process is of malignant nature, secondary operation may then be performed

A total of 43 cases taken from the literature may be divided into three groups seven of these involved the ileum alone Thirteen involved the ileum and cecum and in some of these 13 there was additional involvement of other portions of the large or small bowel Twenty-three involved only the large intestine exclusive of the cecum

In the ileum alone, the seven case reports show seven resections with one death and two recurrences requiring secondary operation The 13 case reports with ileum and cecum involved showed the following results With nine resections, five cures occurred The other four cases had two

TABLE I

ANALYSIS OF CASES REVIEWED IN THE LITERATURE

Part Involved	Age	Sex	Treatment	Result	Comment	Reported By
Esophagus			Gastrostomy	Cure		Robson 1908
Pylorus	31	M	Gastro enterostomy	Cure	Ulcer?	Robson 1908
Pylorus	45	M	Gastro enterostomy	Cure	Ulcer?	Robson 1908
Pylorus	48	M	Gastro enterostomy	Cure	Ulcer?	Robson 1908
Pylorus	50	M	Diet and rest	Cure	Ulcer?	Robson 1908
Stomach	56	F	Resection	Cure	Ulcer?	Mock 1931
Stomach	52	F	Resection	Cure	Ulcer?	Mock 1931
Stomach duodenum and pancreas	38	M	Resection	Death	Ulcer?	Mock 1931
Stomach	54	M	Resection	Death	Ulcer?	Kolodny 1935
Stomach	43	M	Resection	Cure	Ulcer?	Kolodny 1935
Ileum	20	M	Resection	Two recurrences		Coffin 1925
Ileum	25	M	Resection	Death (strang hernia)	Torn meso	Mock 1931
Small intestine	31	M	Resection	Cure	Pneu death (1 mo)	Cave 1931
Ileum	52	M	Resection	Cure	Ulceration	Andrews 1932
Ileum	30	F	Resection	Cure		Hanford 1933
Ileum	42	F	Resection	Cure		Erdmann and Burt 1933
Ileum	24	M	Resection	Death		Harriss Bell and Brunn 1933
Ileum	28	F	(*a*) Short-circuit (*b*) Resection	Cure	Two operations	Bockus and Lee 1935
Cecum and ileum	23	M	Resection	Cure		Jones and Eisenberg 1918
Cecum and ileum	23	M	Resection	Fistula abscess	2nd resec	Moschowitz and Wilensky 1923
Cecum and ileum	22	F	Resection	Cure	Primen suture	Mock 1931
Cecum and ileum	18	M	Resection	Cure		Erdmann and Burt 1933
Cecum and ileum	39	F	Resection	Cure		Erdmann and Burt 1933
Cecum ileum and colon	60	F	Resection	Death	2nd resec (fistula)	Erdmann and Burt 1933
Cecum and ileum	37	F	I and D abscess	Fistula	2nd resec	Erdmann and Burt 1933
Cecum and ileum	30	F	Resection	Cure		Molesworth, 1933
Cecum and ileum	49	F	Resection	Abscess	2nd I and D	Gordon 1933
Cecum and ileum	21	F	Appendicectomy	Fistula		Janssen 1933
Cecum and ileum	64	M	Short circuit and Roentgen ray	Cure	2nd ex oper	Eggers 1933
Cecum and ileum	18	F	Resection	Death		Harriss Bell and Brunn 1933
Cecum and ileum	19	F	I and D abscess appendicectomy	Cure fistula	2nd resec	Harriss Bell and Brunn 1933
Cecum	50	M	Resection	Cure		Robson 1908
Cecum		F	Exp celiotomy	Cure		Jones and Eisenberg 1918
Cecum	41	M	Resection	Cure		Golob 1932
Cecum and ascending colon	33	M	Resection	Cure		Moschowitz and Wilensky 1923
Cecum and ascending colon	11	F	Resection	Cure		Moschowitz and Wilensky 1923

TABLE I (*Continued*)

Part Involved	Age and Sex	Treatment	Result	Comment	Reported By
Cecum and ascending colon	57 M	Short circuit and Roentgen ray	Cure		Eggers, 1933
Ascending colon	70	Short circuit	Cure		Robson 1908
Trans colon	50 M	Short circuit	Cure		Robson 1908
Trans colon	50 F	Resection	Cure?		Moynihan 1908
Trans colon	32 F	Resection	2nd abscess	I and D cure	Lee 1917
Trans and splenic colon	62 F	Short circuit	Cure		Moynihan 1908
Splenic flexure small intestine	50 F	Double short circuit	Cure		Robson 1908
Splenic flexure	44 M	Resection	Fistula	2nd oper	Moschowitz and Wilensky 1923
Splenic flexure	20 M	Exteriorized excision	Cure		Mock 1931
Sigmoid	58 F	I and D abscess	Cure	Diverticulitis	Moynihan 1908
Sigmoid	52 M	Colectomy	Cure	Diverticulitis	Moynihan 1908
Sigmoid	7 F	Exp oper	Cure		Ashurst 1908
Sigmoid (tubes and ovaries)	49 F	Exp oper	Cure		Mock 1931
Colon and ileum	M	Resection	Recurrence	Two—2nd opers	Coffin 1925
Rectum	28 F	Colostomy—Ab pern sec	Cure		Moynihan 1908
Rectum	50 M	Colostomy	Cure	Closure	Robson 1908
Rectum	50 M	Colostomy	Cure	Closure	Robson 1908
Rectum	56 F	Resection	Cure	Diverticulitis	Giffin 1911

deaths with three secondary fistulae and two secondary abscesses requiring four additional operations One death followed a primary operation and one a secondary resection for fistula One fistula persisted The two cases with secondary abscesses, both of which were incised and drained, ended with two fistulae which were both reoperated upon a third time Four conservative operations were performed in this group One short circuit followed by radiotherapy yielded a cure as did one appendicectomy Incision and drainage of two primary abscesses resulted in two fistulae, which also were subsequently resected

It is to be noted that three deaths, two recurrences, two secondary abscesses and three secondary fistulae requiring eight additional operative procedures do not incline one to consider that this type of surgery is all that is to be desired It is certainly worthy of consideration, from a diagnostic standpoint, that all four cases having abscesses that were incised and drained, subsequently developed fistulae of an ileal type which tended to persist for a long time

The 23 cases involving the large bowel showed these results With 11 resections eight cures resulted, with two recurrences, two fistulae, and one abscess In 12 cases conservative surgery yielded 12 cures Seven of these 12 had a short circuiting procedure performed, and all recovered without any complications

If the latter two groups of cases, totaling 36, are considered together these results may be observed Twenty resections yielded 13 cures, with two deaths from primary operation, two recurrences requiring two secondary operations, resulting in one death, five persistent fistulae and three secondary abscesses all requiring reoperation In 16 of these cases, conservative surgery of one type or another yielded 13 cures Short circuiting performed eight times showed eight cures, exploratory celiotomy in four cases, three cures, exteriorization in one case, one cure, incision and drainage in three cases, one cure with two persistent fistulae Omitting those cases that had only incision and drainage of an abscess from this group of 16, conservative surgery showed only one case without a favorable result This may be contrasted, very definitely, with the frequent complications resulting from radical surgery

The appended case reports are from the Second Surgical Division of Bellevue Hospital, New York

CASE REPORTS

Case 1 —S T , female, age 47, white, was admitted to the hospital April 17, 1926, with a seven weeks' history of irregularly, recurrent pain in the left lower quadrant with some nausea but no vomiting Previously she had been quite constipated There had been no weight loss

She was subacutely ill without abnormal physical findings other than those localized to the abdomen In the left lower quadrant there was a firm, round, orange-sized mass slightly tender and fairly mobile Rectal and vaginal examinations were normal

The temperature varied between normal and 101° F , white blood cells, 17,200, polymorphonuclears, 85 per cent, red blood cells, 4,500,000, hemoglobin, 95 per cent, stools negative for blood, Wassermann negative, blood chemistry normal, cystoscopy normal, proctoscopy showed no visible pathology Roentgenologic examination revealed incomplete obstruction of the midsigmoid

She was operated upon 12 days after admission and a large, mobile mass was found in the left lower quadrant This was composed of inflamed, thickened and adherent omentum and sigmoid colon Several small abscesses were encountered during the exploration A small splinter of wood about 2 cm long was found in this mass when the omentum was separated from the sigmoid However, no perforation of the sigmoid was seen The splinter was removed and the abdomen closed with drainage

The patient made an excellent convalescence, having been discharged on her twenty-fourth postoperative day, with the wound completely healed For three years she has had no recurrence of symptoms and the mass has disappeared

Case 2 —G M , male, age 42, white, was admitted September 18, 1934, with a two day history of abdominal pain most marked in the left lower quadrant He had had considerable vomiting and some dysuria His past history elicited no prominent symptoms He was acutely ill, dehydrated and had a distended and tender abdomen Rectal examination showed marked tenderness on the left side No mass was palpated Temperature, 101 4° F , urine, negative, white blood cells, 12,600, polymorphonuclears, 82 per cent

He was operated upon shortly after admission and a diffuse peritonitis was found In addition, the sigmoid was grossly inflamed and thickened and had many inflammatory adhesions about it The abdomen was closed with drainage

He had a stormy convalescence and was discharged on his thirtieth postoperative day The wound healed completely without the formation of a fistula Subsequent studies have

proven the presence of multiple diverticula of the sigmoid The inflammation of one of these doubtless accounted for his illness

Case 3—M R, female, age 37, was admitted August 1, 1933, with a three months' history of cramping, epigastric pain after meals Alkalies eased the pain irregularly but vomiting gave constant and immediate relief She remembered having had tarry stools several times She had lost about 40 pounds in three to four months Episodes of epigastric pain with vomiting had recurred for nine years and during this period repeated observation in various hospitals had resulted in no definite diagnosis Three years before her admission, hematemesis and melena had been noted for the first time, and during the last three years both of these have recurred on several occasions

She was a markedly emaciated young female, appearing chronically ill and complaining of fairly severe epigastric pain Her head, neck, lungs, heart and extremities revealed no positive findings The abdomen was soft, nontender, not distended and no masses were palpable Rectal and vaginal examinations were negative

Temperature rose to a maximum of 101° F on several days Pulse and respirations normal Blood pressure, 98/72, urine, negative, white blood cells, 8,400, polymorphonuclears, 74 per cent, red blood cells, 4,500,000, hemoglobin, 80 per cent Wassermann, negative, blood chemistry, normal Repeated G I series showed only a very large atonic stomach and dilated duodenum

After having left the hospital against advice on three occasions she finally consented to an exploratory celiotomy because of almost constant vomiting She was operated upon August 15, 1933, with a preoperative diagnosis of high obstruction

The operative findings consisted of a markedly dilated stomach and duodenum, a lemon sized mass in the jejunum, six inches below the angle of Treitz, causing almost complete obstruction, many soft small lymph nodes were found in the mesentery at this point The mass was resected and a side-to-side anastomosis done and the abdomen closed without drainage

Postoperatively a wound infection cleared fairly rapidly She progressed well for about two weeks when the vomiting recurred Conservative measures were of no avail Roentgenologic studies again showed marked dilatation of the stomach and duodenum It was felt that she might have been obstructed at the jejunojejunostomy stoma and she was reoperated upon September 27, 1933, six weeks after her first operation

The abdomen contained a mass of adhesions between both the parietal and visceral peritoneum The anastomosis appeared patent The first portion of the jejunum was slightly hypertrophied and had a granular appearance An anterior gastro-enterostomy was performed with an entero-anastomosis 20 inches below the angle of Treitz The wound healed by primary union and she made good progress for another two weeks At this time recurrence of vomiting seemed to indicate another obstruction from adhesions and she was reoperated upon November 4, 1933, six weeks after the second operation

At operation the gastro-enterostomy and both entero-anastomoses were apparently functioning The peritoneal cavity contained a mass of adhesions The stomach was not dilated The exploratory celiotomy, with lysis of the adhesions, was completed Postoperatively she made some progress for about two weeks but died suddenly on the sixteenth postoperative day, approximately 30 hours after a recurrence of the vomiting

Pathologic examination of the tissue removed from the jejunum at the first operation showed a stenosing lemon-sized tumor of the jejunum It was interpreted as a chronic, productive inflammatory tissue The mucosa was slightly ulcerated and the tumor showed a marked amount of fibrosis with infiltration by many lymphoid cells Some giant cells were also present

Autopsy revealed the presence of two other similar tumors, one in the duodenum and one low down in the jejunum The origin of these tumors is unknown

Case 4—M M, female, age 46, white, was admitted in December, 1934, with a one week's history of generalized abdominal cramps, with considerable nausea and vomiting and slight diarrhea She believed this to be due to some type of food poisoning With the

onset of fever and some abdominal distention accompanied by constipation, she came to the hospital She admitted having had some irregular lower abdominal pain with constipation for a few months before the present illness

She was well developed and well nourished but chronically ill Examination showed only abdominal distention and tenderness in both lower quadrants A slight cystocele and rectocele were present, and the culdesac was slightly boggy but not tender

Temperature on admission 103° F , pulse and respirations, normal, urine, negative, blood pressure, 105/70, white blood cells, 12,000, polymorphonuclears, 78 per cent, Wassermann, negative, Widal, negative, red blood cells, 4,000,000, hemoglobin, 70 per cent The stool was negative for blood Culture and direct examination of the stool showed no abnormal findings Proctoscopy negative A barium enema, which was repeated, showed finger printing in the sigmoid and was interpreted as an infiltrative lesion A diagnosis of possible foreign body perforation of the sigmoid with abscess formation was made, and operation carried out January 9, 1935

Operation —The pelvis and lower abdomen were a mass of adhesions in which were embedded the tubes and ovaries and the small and large intestines This mass was the seat of an inflammatory reaction, the tissue being of porky consistency The sigmoid was incorporated in this mass and its wall was tremendously thickened The tubes were also markedly enlarged There was a small amount of odorless pus, enclosed in the meshes of these adhesions

Both tubes were removed by sharp dissection and an appendicectomy with simple ligation of the stump effected The abdomen was closed with drainage

She died on the eighteenth postoperative day from an acute nephritis and sepsis A postmortem examination revealed a small amount of purulent exudate in the lower abdomen, which showed a hemolytic streptococcus in pure culture as did the pus from the original abscess

Friable adhesions were present throughout the abdomen, particularly low down The wall of the large intestine at the rectosigmoid junction was thickened, firm and indurated without ulceration of the mucosa The ileum and small intestine were intimately adherent to this mass Microscopic examination of this tumor of the rectosigmoid region showed a chronic productive inflammatory reaction with an increase in the connective tissue, infiltration by lymphoid cells and some edema The surgical specimen was reported as showing a chronic productive salpingitis

Although the origin of this tumor of the rectosigmoid junction is not definitely established it seems probable that it may be due to progression from the pathologic process in the tubes

Case 5 —T G , female, age 61, white, was admitted June 10, 1935, with a four months' history of cramplike abdominal pain with nausea and irregular vomiting She had noted intermittent constipation with distention She had had no melena or hematemesis She had gradually become weaker during the past two months, with a weight loss of approximately 30 pounds She stated that on several occasions she had had some fever

The patient was subacutely ill Examination showed fairly marked tenderness over the lower abdomen, particularly on the left side An irregular suprapubic mass was palpable but could not be definitely outlined On bimanual examination the tumor seemed to be intimately connected with the posterior vaginal wall

Her temperature ran irregularly between normal and 102° F , red blood cells, 4,000,000, hemoglobin, 80 per cent, white blood cells, 11,000, polymorphonuclears, 85 per cent, urine, negative, blood pressure, 140/90, proctoscopic examination, negative, stools negative for blood

At operation, June 14, 1935, an orange-sized mass was found in the sigmoid adherent to the ileum, which caused subacute obstruction of both the ileum and the large bowel The adhesions encapsulated 50 cc of thick, greenish pus

In separating the adhesions the abscess was opened, and in attempting to free the sigmoid from the ileum, a small opening was accidentally made into the large bowel This was closed after a small piece of tissue had been removed for biopsy The wound was closed with drainage

Postoperatively, she developed a fecal fistula which drained for a considerable length of time The patient refused further surgery of any type and left the hospital, returning, however, to the O P D for subsequent dressings The fistula persisted for approximately one year when it finally closed spontaneously It is now a year and one-half since operation and the patient is in excellent health

The specimen removed from the tumor in the rectosigmoid region showed a dense granulation tissue in which there were numerous vessels Considerable fibrous tissue of a dense character, with numerous fibroblasts, was present and was infiltrated by many round cells

Case 6—C L, male, age 40, white, was admitted May 15, 1934, complaining of epigastric pain of ten years' duration This occurred about an hour after each meal and was relieved by alkalies and emesis There was no history of hematemesis or melena During the past month he had had almost constant vomiting, having been able to retain only fluids He had been operated upon previously for hemorrhoids and for a perforated appendix, both in 1932

The patient was emaciated No abdominal tenderness was present No mass was palpated Temperature, pulse and respirations normal Urine, negative, white blood cells, 15,000, polymorphonuclears, 70 per cent, red blood cells, 5,000,000, hemoglobin, 100 per cent, gastro-intestinal roentgenograms showed complete retention of the gastric meal at 24 hours

At operation, May 16, 1934, an orange-sized mass was found in the first portion of the duodenum and extended slightly over onto the gastric side There were many adhesions to the surrounding structures No metastases were felt

A posterior gastro-enterostomy was performed, although it was felt that the tumor might be a carcinoma A lymph node was taken for biopsy

The patient made an uneventful postoperative recovery and left the hospital on the eighteenth postoperative day, against advice Since that time he has gained 35 pounds in weight Gastro-intestinal roentgenologic studies show good function of the gastro-enterostomy stoma, with a slight area of narrowing of the proximal jejunum about one-half inch distal to the site of anastomosis The lymph node was reported to show subacute and chronic inflammatory changes without evidences of malignant disease It is two and one-half years since operation and the patient is now enjoying excellent health

Case 7—F A, male, age 54, white, was admitted February 1, 1932, with a 15 year history of epigastric pain with irregular vomiting The pain had recurred frequently during this time He had lost considerable weight He was emaciated The abdomen was soft and nontender No mass was palpated Rectal examination was negative

Temperature, pulse and respirations normal Urine, normal, red blood cells, 4,000,000, hemoglobin, 80 per cent, white blood cells, 9,500, polymorphonuclears, 70 per cent, stools negative for blood, gastric analysis showed both free and combined acid, gastro-intestinal roentgenologic examination demonstrated an ulcer of the first portion of the duodenum with considerable residue at 24 hours

At operation a lemon sized tumor was found in the first portion of the duodenum mainly on the anterior and inferior duodenal wall A crater was palpated in the center of the tumor No metastases were present in the liver although there were many fairly large regional nodes A posterior gastro-enterostomy was performed with biopsy of a regional node The patient made an uneventful recovery except for a slight wound infection and was discharged from the hospital on the twenty-seventh postoperative day

The biopsy of the regional node was reported to show chronic inflammation without evidence of malignant disease

The patient has been followed for nearly five years and has had two hernias repaired

during that time He has gained approximately 40 pounds in weight and has absolutely no gastric symptoms

These latter two cases may be called duodenal ulcers with chronic productive inflammation around them causing tumor formation

Case 8—J K, male, age 60, white, was admitted in May, 1921, with a 48 hour history of lower abdominal pain and vomiting Examination showed an acutely ill patient with a temperature of 101° F, and leukocytosis of 23,000 No palpable abdominal mass Preoperative diagnosis was acute diffuse peritonitis

Operation revealed a mass within the pelvis involving the lower segment of the sigmoid and upper rectum The mass did not have the consistency suggestive of carcinoma A peach pit which had ulcerated through the inflamed colon was found and removed No other pathologic specimen A diffuse lower abdominal peritonitis was present A sigmoid colostomy was performed and the peritoneal cavity was drained Death on the ninth postoperative day No autopsy

This case was an inflammatory tumor resulting from a foreign body

Case 9—G F, male, age 55, white, was admitted in October, 1935, with a four months' history of frequent and painful defecation There was no history of blood in stools Positive physical findings were confined to rectal examinations Digital examinations showed hard, tender mass on the anterior rectal wall at tip of finger Proctoscopic examination showed no ulceration, no bleeding A biopsy specimen was reported as chronic inflammatory process Roentgenologic examination of lungs, lumbar spine and pelvis showed no metastases Temperature 99 6° F, erythrocyte count, 4,400,000, hemoglobin, 86 per cent, leukocyte count, 11,700, polymorphonuclears, 85 per cent Stool negative for blood by chemical examination Preoperative diagnosis Carcinoma of rectum

Operation showed hard, fixed mass the size of an orange at rectosigmoid junction Adjacent loops of small intestine were adherent to the mass No free fluid, no palpable metastasis in liver Condition considered inoperable carcinoma Node removed from pelvis adjacent to mass Sigmoid colostomy performed

Pathologic report of this node, chronic lymphadenitis

Readmitted in March, 1936, for proctoscopic examination Twenty-six pound weight gain Spinal anesthesia Two proctoscopes inserted, one through anus and one through colostomy Impossible to make the two proctoscopes meet No erosion no bleeding On left side of rectum a hard mass, outside the gut, could be felt No biopsy

This case very suggestive of inflammatory tumor of rectosigmoid with cicatricial stenosis

Case 10—G N, male, age 14, white, was admitted February 5, 1920, complaining of generalized abdominal cramps with vomiting For the past four months he had had recurrent attacks similar to the present one He was emaciated and somewhat anemic The abdomen was symmetrical with some tenderness in the right lower quadrant where there was a mass Temperature rose to 100° F on several occasions Pulse and respirations normal Urine, negative, white blood cells, 14,000, polymorphonuclears, 65 per cent, red blood cells, 3,500,000, hemoglobin, 70 per cent

At operation, February 12, 1920, a tumor involving the terminal portion of the ileum, cecum and appendix was found The ileum and right half of the colon were resected, and an end-to-side anastomosis performed

The patient developed a fecal fistula which persisted for nine months, and on two occasions he developed secondary abscesses around this fistula which required incision and drainage The fistula finally closed and the patient was followed for five years His only complaints during this time were irregular recurrence of pain in the right lower quadrant with opening of the fistula on two occasions

The cecum, ileum and appendix were the seat of a chronic productive inflammatory reaction which was definitely not tuberculous The cecal mucosa was ulcerated There was a fistula between the terminal portion of the ileum and the cecum which was embedded in a mass of adhesions

The origin of the inflammatory reaction in this case was unknown and it represents a case similar to those described under the heading of regional ileitis

Case 11—P F, male, age 37, white, was admitted May 4, 1922, complaining of increasing constipation for five months He has also had, during the last five weeks, irregular cramping pain particularly in the lower abdomen He had lost approximately 40 pounds in two and one-half months He was markedly emaciated and chronically ill In the left upper quadrant there was an orange-sized mass which was fairly tender Rectal examination, negative Temperature, pulse and respirations, normal Urine, negative, white blood cells, 9,000, polymorphonuclears, 82 per cent, red blood cells, 3,600,000, hemoglobin, 70 per cent Stool negative for blood Barium enema showed defective filling at the splenic flexure

At operation, May 12, 1922, a large mass was found involving the splenic flexure of the colon This was resected and a side-to-side anastomosis performed The abdomen was closed with drainage The patient died on the fourth postoperative day, having developed a severe pulmonary infection

The wall of the large intestine was markedly thickened and firm, forming a tumor about five inches long and four inches in diameter The mucosa was ulcerated There was marked fibroblastic proliferation in the wall of the gut with infiltration with many plasma cells

This was interpreted as a chronic productive inflammatory reaction probably on the basis of a colitis

CONCLUSIONS

It should be emphasized that these tumors occur throughout the gastrointestinal tract and that, while the etiology varies, the pathology is essentially the same in all regions It is our belief that incision and drainage alone is indicated in the presence of abscess, even though fistulae may persist In the presence of intestinal obstruction nothing but conservative surgery should be carried out In the absence of abscess, side-tracking and regional node biopsy carries a lower mortality and a lower incidence of complications than resection The observation of Moschowitz and Wilensky, that the disease is often cured by this type of procedure, still holds good In addition, conservatism provides the opportunity for subsequent operation when required by a confirmed diagnosis of malignant disease

It is to be noted that the problem lies more in avoiding radical surgery with its high mortality in a condition not demanding it than in assuming radical surgery to those individuals who may not be benefited by it

The authors wish to express their appreciation for the generous aid of Dr Rudolf M Paltauf, in the translation of foreign literature

REFERENCES

[1] Virchow Virchows Archiv, 5, 335 ff, 1853

[2] Moynihan, B G A Mimicry of Malignant Disease in the Large Intestine Edinburgh Med Jour, 21, 228, 1907

[3] Robson, A W M An Address on Some Abdominal Tumors Simulating Malignant Disease and Their Treatment British Med Jour, 1, 425, 1908

Ibid The Hunterian Lecture, Duodenal Ulcer and Its Treatment British Med Jour, February 2, 248, 1907
[4] Braun, H Deutsch Ztschr f Chir, 1, 12, 100, 1909
[5] Giffin, H Z ANNALS OF SURGERY, 53, 533, 1911
[6] Proust and Lejars Quoted by Coffen, T H J A M A, 85, 1303, 1925
[7] Hamann, C A ANNALS OF SURGERY, 51, 782, 1910
[8] Lee, B J ANNALS OF SURGERY, 65, 265, 1917
[9] McGrath, B F Intestinal Diverticulae Their Etiology and Pathogenesis Surg, Gynec, and Obst, 15, 429, 1912
[10] Telling Lancet, March 21, 1908, 28 Quoted by McGrath
[11] Moschowitz, E, and Wilensky, A O Non-specific Granulomata of the Intestines Am Jour Med Sci, 166, 48, 1923
[12] Barron, M E Simple Non-specific Ulcer of the Colon Arch Surg, 17, 355, 1928, and Surg, Gynec, and Obst, 870, May, 1930
[13] Mock, H E Infective Granuloma Surg, Gynec, and Obst, 52, 672, 1931
[14] Wilensky, A O Non-specific Granuloma of the Intestine Med Jour and Rec, 135, 445, 1932
[15] Raiford, T S Arch Surg, 25, 148, July and August, 1932
[16] Erdmann, J F, and Burt, C V Non-specific Granuloma of the Gastro-Intestinal Tract Surg, Gynec, and Obst, 57, 71, 1933
[17] Crohn, B B, Ginzburg, L, and Oppenheimer, G D Non-specific Granulomata of the Intestines ANNALS OF SURGERY, 98, 1046, December, 1933
[18] Harris, Bell, & Brunn Chronic Cicatrizing Enteritis Surg, Gynec, and Obst, 57, 637, 1933
[19] Jones, N M, and Eisenberg, A A Inflammatory Neoplasm of the Intestines Simulating Malignancy Surg, Gynec, and Obst, 27, 420, 1918
[20] Bull, W T Accidents Which May Follow Removal of Portions of the Omentum in Operations for Hernia ANNALS OF SURGERY, 17, 269, 1893
[21] Pack and Davis Carcinoid Tumors of the Small Intestines Am Jour Surg, 9, 472, 1930
[22] Weinstein, M L Lympho-sarcoma of the Jejunum Am Jour Surg, 17, 355, 1932
[23] Mayo, C H Quoted by Jones and Eisenberg
[24] Kauffman Lehrbuch der Spez Path, 1, Walter de Gruyter, Berlin, 1931
[25] Harris and Rosenblum Primary Carcinoma of Jejunum Arch Surg, 23, 805, 1931
[26] King, E L Benign Tumors of the Intestines with Special Reference to Fibroma Surg, Gynec, and Obst, 25, 54, 1917
[27] Liu, J H Tumors of the Small Intestine with Special Reference to the Lymphoid Cell Tumors Arch Surg, 11, 602, 1925
[28] Fiedler, F W Benign Tumors of the Small Intestines Memphis Med Jour, 9, 185, October, 1932
[29] Davies, J H T Proc Royal Soc Med, 26, 128, 1932
[30] Gregory, H H C Two Case Reports of Melena Caused by Innocent Growths of the Small Intestine Brit Jour Child Dis, 29, 197, 1932
[31] Golob, M Infectious Granuloma of the Intestines with Special Reference to the Difficulty of Pre-operative Differential Diagnosis Med Jour and Rec, 135, 390, 1932
[32] Coffen, T H Non-specific Granuloma of the Intestine Causing Intestinal Obstruction J A M A, 85, 1303, 1925
[33] Ewing, J Neoplastic Disease W B Saunders, page 42, Philadelphia, 1928
[34] Molesworth, H W L Granuloma of the Intestine Brit Jour Surg, 34, 21–370, 1933–1934
[35] Gordon, D ANNALS OF SURGERY, 97, 130, 1933
[36] Hanford, Jannssen, and Eggers Discussion of Gordon's Paper ANNALS OF SURGERY, 97, 130, 1933

[3] Monsarrat British Med Jour, 2, 65, 1907
[38] Rankin, F W, and Major, S G Tumors of the Mesentery Surg, Gynec, and Obst, 54, 809, 1932
[39] Rankin, F W, and Newell C E Benign Tumors of the Small Intestine Surg, Gynec, and Obst, 57, 501, October, 1933
[40] Rankin, F W, and Mayo, C, 2nd Carcinoma of the Small Bowel Surg, Gynec, and Obst, 50, 939, 1930
[41] Cave, H W Tumors of the Small Intestine ANNALS OF SURGERY, 96, 269, 1932
[4] Ulman, A, and Abeshouse, B S ANNALS OF SURGERY, 95, 875 1932
[43] Jennings, J E ANNALS OF SURGERY, 93, 828, 1931
[44] Hartwell and Cecil Am Jour Med Sci, 140, 174, August, 1910
[45] Clifton, H C, and Landry, B B Boston Med and Surg Jour, 8, 197, July 7, 1927
[46] Barker, L F Internat Clin, September, 1931
[47] Andrews, C Obstruction of the Small Intestine Due to Benign Granuloma Nebr State Med Jour, 17, 106, 1932
[48] Kolodny, A Infective Granuloma of the Stomach ANNALS OF SURGERY, 102 30, July, 1935
[49] Ashurst ANNALS OF SURGERY, 47, 300, 1908
[50] Bockus, Henry L, and Lee, Walter Estell Regional (Terminal) Ileitis ANNALS OF SURGERY, 102, 412–421, September 1935

DISCUSSION.—DR CARL EGGERS (New York) said that it would be helpful if a common terminology could be found for these conditions The name proposed by Doctor Dudley, namely, "nonspecific granuloma" or "inflammatory tumors of the gastro-intestinal tract" may serve very well It seems better than to have a specific name for inflammatory tumors in each section of the gastro-intestinal tract Somehow he had never had under his care a patient with an inflammatory tumor of the lower ileum other than tuberculous However, he had come in contact with inflammatory tumors of the pyloric region, so-called hypertrophic tumors or hypertrophic ulcers, as well as with inflammatory tumors of the cecum and especially the sigmoid

The first pyloric case encountered was in a man who, four years previously, had had a diagnosis made of inoperable carcinoma of the stomach and a gastro-enterostomy with a Murphy button had been performed He came in now with recurrence of his symptoms It was learned that the button had apparently not passed Roentgenologic examination showed a foreign body in his stomach He was operated upon and the two cylindrical portions of the button, the so-called male and female part, were recovered from his stomach, the remainder seemed to have been digested There was no sign of a tumor The gastro-enterostomy was intact The man died of postoperative pneumonia At autopsy the steel spring of the button was found to be stuck in the pylorus, it had not shown in the roentgenogram Since then he had seen a number of large tumors in this region They bring out a point stressed by Doctor Dudley, namely, that a side tracking operation is safe and is an ideal procedure in these cases Most cases are cured by a gastro-enterostomy, but one has to be sure not to overlook a carcinoma

Two cases with large palpable tumors of the cecum were of interest The first case of this type was seen many years ago He had intestinal symptoms and a palpable mass Various diagnoses were suggested, ranging from tumor of the colon to tumor of the kidney The roentgenologic examination was not conclusive At operation there was found a large tumor occupying the cecum and ascending colon extending into the mesentery, and evidently inoperable An ileocolostomy was performed, after which he was given some roentgenotherapy more as a palliative measure than

with the intention of curing the lesion, and he did very well The mass disappeared completely and he has had no symptoms since

Four years ago a second case came under observation which presented a large palpable tumor of the cecum, with obstructive symptoms He was an old cardiac case An ileocolostomy was performed as a preliminary procedure, with the intention of removing the tumor at a second stage A few weeks later when his heart condition had improved, reoperation to remove the tumor was undertaken and it was found that the mass had disappeared It has not recurred

Both of these cases illustrate the value of a side tracking operation in the presence of these inflammatory tumors Unfortunately we do not know the pathology of these cases, since no pathologic examination was possible They were evidently large granulomata

Inflammatory tumors of the sigmoid seem to be the most common, and one can distinguish two groups of cases In some patients one has diverticula and diverticulitis, in others, there are large palpable tumors of the sigmoid in whom one does not see any diverticula in the roentgenograms or at operation This constitutes a rather interesting group Dr Eggers has collected 51 personally observed cases of inflammatory conditions of the sigmoid giving symptoms sufficiently severe to require surgical consultation or operation In most instances, consultation only Sometimes these tumors were very large In a few instances a diagnosis of ovarian cyst or ovarian tumor was made in the beginning Some have had very high fever, usually with a high leukocyte count Another surprising feature has been the speed with which they may disappear after rest in bed, emptying of the bowel, and other measures In a number of instances we operated and found a large tumor, which looked inflammatory, red, partly covered with fibrin and unlike carcinoma If one has seen a number, one may differentiate with reasonable certainty After making the diagnosis, the tumor, in some instances has not been resected, but has been replaced and the patients have recovered The mortality connected with resection is known and if one can recognize the tumor as inflammatory in character, one may be conservative

He recalled an interesting case, seen in 1930, with a tumor which reached to the umbilicus She had been in bed with fever for a few weeks It had been diagnosed as a tubo-ovarian condition but on questioning, symptoms of an intestinal disorder were elicited At operation a large tumor in the pelvis adherent to the bladder, anterior and lateral abdominal wall and adnexa was found She had a very high leukocytosis—up to 50,000 The mass was apparently an inflammatory one Resection was not performed, but the mass was liberated and placed in a more favorable position higher in the abdomen where it would not be so likely to reform adhesions The lymph nodes of the mesentery which drained the tumor were cultured but no growth obtained After a prolonged convalescence the patient recovered and she has had no recurrence of symptoms since During her convalescence she was given roentgentherapy, which in some of these inflammatory conditions appears to be of value

Doctor Eggers then presented a series of lantern slides in order to illustrate certain points connected with the diagnosis of sigmoiditis and diverticulitis, as well as its possible underlying pathology The first was that of a patient who had been admitted on two different occasions, with several years' interval Each time she presented a large palpable tumor which subsided in five or six days with rest in bed application of an icebag and attention to the bowels No diverticula were ever demonstrated

The next showed a middle-aged female, who presented a tumor in the left lower abdomen with symptoms suggestive of a sigmoid lesion rather than a pelvic mass The roentgenologic examination was reported negative A year later she was seen again, and bearing in mind the previous negative roentgenologic finding, a diagnosis of pelvic disease was made At operation a rather hard inflammatory tumor of the sigmoid was found It was replaced and the abdomen closed without drainage Subsequent roentgenologic examinations, especially after defecation, showed what was considered to represent a typical sigmoiditis Four years have passed, and though the patient has had occasional intestinal symptoms, she has remained well The modern technic of visualizing sigmoid lesions, particularly after defecation, is most important

Another interesting case was one in whom a diagnosis of sigmoiditis had been made on the basis of intestinal symptoms and a palpable mass It had been verified roentgenologically His diet was regulated and mineral oil administered A year later he was taken acutely ill, with what was thought to be acute appendicitis Knowing that he had diverticula of the sigmoid, perforation of this segment of the gut was considered There were signs of peritonitis over the entire lower abdomen At operation fluid was evacuated, and the appendix removed It did not explain the symptoms The sigmoid was inspected It was red, hard, and covered with fibrin No gross perforation was seen, it was evidently closed off by fibrin The tumor mass was replaced and the abdomen drained He made a good recovery Culture of fluid showed colon bacilli and streptococci Intestinal symptoms consisting of pain and vomiting, and suggesting obstruction continued A resection was performed about six months later with a good result

A fourth case was that of an elderly male, in whom a diagnosis of carcinoma of the sigmoid had been made He had pain, tenderness and a palpable mass Roentgenologic examination demonstrated a small diverticulum next to the mass Diagnosis of sigmoiditis was made and as the patient was not a good surgical risk, roentgentherapy and observation were advised He continues to remain well, six years later

A fifth case illustrated the value of taking roentgenograms before and after defecation as the lesion may show after defecation, when it does not do so before This patient had a palpable tumor apparently with a perforation of the lumen of the gut into the mass It was resected and found to be inflammatory Careful microscopic studies had been made, and it had been determined that the lesion was the result of perforation of a diverticulum into the wall of the gut

Dr Eggers thought that in a case, such as that just cited, one may obtain a clue to the etiology of some of these inflammatory tumors of the gastro-intestinal tract A foreign body may be considered to be the cause in some cases A few of the cases, cited herewith may have had a mucosal ulcer as the port of entry In two instances it was apparently a perforation of a diverticulum into the wall of the gut The mucosa was normal, but there was an infected diverticulum in the wall It was the speaker's feeling that infected diverticula were probably frequently the cause of inflammatory intestinal tumors One may visualize the process as follows We usually picture a diverticulum as projecting beyond the serosa of the gut wall Perforation of such a diverticulum may form a local abscess or peritonitis However, a diverticulum has a beginning, and before it projects beyond the serosa, it must work its way between the fibers of the gut wall At any time during this process, stagnation and infection may occur As the result of the increased tension it may perforate in different directions The

reason many of these inflammatory tumors subside is because they perforate into the lumen and drain that way Others perforate into the wall, spread along between the layers and form the large hard tumors we sometimes see Still others perforate externally and form a local abscess or peritonitis

DR PERCY KLINGENSTEIN (New York) thought that Doctor Dudley had brought out very important considerations in connection with the cases cited In the future, now that attention has been drawn so actively to this condition, with refinements in roentgenology, so that the small intestine will become less a silent field in roentgenologic study of the abdomen, more accurate preoperative diagnosis will be made The lesions, as Doctor Eggers stated, do tend to localize on the left side, yet in Doctor Klingenstein's experience there have been a number localized on the right side The factor accounting for this is not known A more exact classification could be made if the etiology were more definitely understood

DR SEWARD ERDMAN (New York) asked Doctor Dudley whether, in looking up the literature, he had noted that the majority belonged in the cancer age group If so, this would be in contrast to the many patients shown during the meeting who were young, in a number of instances Doctor Erdman was also surprised to observe that so many of the cases were on the right side

DR GUILFORD S DUDLEY (closing) answered that his impression regarding age has been that those inflammatory lesions involving the small intestine and particularly the ileum, or ileum and cecum, tend to be in a younger age group, whereas those involving only the large intestine tend to occur in older patients, that is, in the cancer age group Common terminology was the thought uppermost in mind in captioning the paper presented "Inflammatory Tumors of the Gastro-intestinal Tract" being chosen in preference to one that would have been confined to any particular portion of the tract

DR LAURENCE MISCALL (closing) pointed out that in the literature the occurrence of inflammatory tumors throughout the gastro-intestinal tract is generally recognized Many authors have noted minor variations in the pathologic picture and an abundance of etiologic factors in the different parts affected The common occurrence of fistulae and abscesses complicating radical operative procedures on inflammatory tumors of the gastro-intestinal tract is impressive These complications have often required secondary or tertiary reoperation The conservative procedures seem indicated First, they may cure the patient Second, they may reduce the incidence of complications Third, if reoperation becomes necessary it may be carried out when the acute infectious stage may have subsided and been replaced by fibrosis

NONSPECIFIC GRANULOMATA OF THE INTESTINE*

RALPH COLP, M D
NEW YORK, N Y
FROM THE SURGICAL SERVICE OF THE MOUNT SINAI HOSPITAL NEW YORK, N Y

THE appended case reports are presented as instances of nonspecific granulomata of the intestines The first five are examples of regional ileitis, a pathologic and clinical entity described by Crohn, Ginzburg and Oppenheimer,[1] in 1933 While the various clinical courses of this condition may be divided arbitrarily into groups, according to their symptomatology, the disease is so protean in its clinical manifestations that it is rarely diagnosed preoperatively The diagnosis in Case 1 was made by the roentgenologist, and in Cases 2, 3, and 4, only at the time of operation The surgical treatment is far from standardized and the efficacy of the various procedures employed will be determined, and correctly evaluated, only after careful follow-up examinations have been made over long periods of time

The type of operation for regional ileitis should be largely determined by the extent of the pathology of the diseased ileum Undoubtedly some of the proven milder cases result in spontaneous recovery, but it would seem better judgment in the early ones to divide the ileum through healthy bowel and sidetrack the fecal current A secondary resection may be performed later should the disease progress If, however, the ileitis has advanced to marked stricture and internal fistula formation, as was present in Cases 3 and 4, resection of the involved bowel in one stage is probably the safest procedure Radical resection, however, apparently does not guarantee against recurrence of this condition because cases of this nature have already been reported Case 5 is one of this type In 1931, an ileocecal resection for nonspecific terminal ileitis was performed, removing about 40 cm of the ileum, the cecum, and portion of the ascending colon Roentgenologic examination, in 1933, showed some irregularity of the anastomosed terminal ileum, but it was not until 1936 that the patient began to complain of increasing abdominal pain At this time the roentgenologic examination revealed marked changes in the terminally anastomosed ileum, which operation verified The ileum was divided again through healthy bowel, and an ileosigmoidostomy was performed The prognosis in these particular cases must be guarded

Case 6 is presented as another type of nonspecific granuloma of the intestines, classified by Ginzburg and Oppenheimer as belonging to the group of localized hypertrophic colitis Similar to the majority of these cases, this patient gave a history of a mild colitis accompanied by temperature Physical examination disclosed a palpable mass in the right lower quadrant Roent-

*Read before the New York Surgical Society, November 25, 1936 Submitted for publication March 4, 1937

genologic examination revealed a constricting lesion confined to the right half of the bowel Because of the patient's poor general condition, it was decided to perform a two stage procedure for resection of the right half of the colon Following division of the terminal ileum and performance of an ileosigmoidostomy the patient improved so markedly that the second stage was deemed unnecessary An ileosigmoidostomy was elected in preference to an ileotransverse colostomy because it was felt that the right half of the colon would be put at almost complete rest by this procedure Subsequent roentgenologic examinations by means of a barium enema apparently supported this contention

CASE REPORTS

Case 1—No 391710 M K, female, age 43, was admitted to the surgical service of the Mount Sinai Hospital April 4, 1936 One year before admission, the patient experienced several attacks of abdominal pain associated with nausea and diarrhea, each of which lasted two weeks During the past six months she had several episodes of abdominal pain associated with nausea, vomiting and diarrhea, usually following the ingestion of spicy foods Coincidently, she noticed pain and discomfort about the anus, and small amounts of blood in the bowel movement

Physical Examination—Negative except for the presence of hemorrhoids Sigmoidoscopy was negative A barium enema was given and although the roentgenogram of the colon was negative, the ileum showed definite pathology The gastro-intestinal series, with special reference to the ileum, showed the presence of an ulcerative lesion involving more than two feet of the ileum, not involving the cecum

Operation—May 15, 1936 Under spinal anesthesia, exploration revealed the typical findings of a regional nonspecific ileitis involving about 18 inches of the terminal ileum This was evidenced by a marked leathery contraction of the bowel with intervals of several strictures and intervening dilatation of the diseased bowel The mesentery was edematous, thickened and shortened, and there was marked enlargement of the mesenteric nodes A typical side-to-side isoperistaltic ileosigmoidostomy was performed after division of the ileum proximal to the lesion The postoperative course was uneventful, and the patient was discharged April 26, 1936

The patient was last seen March 4, 1937 She had gained about ten pounds in weight and felt absolutely well Her bowels moved three times a day and the stools were normal in consistency She had had no recurrence of the cramps Roentgenologic examination, following a barium meal, disclosed no abnormality, other than the defect occasioned by the ileosigmoidostomy

Case 2—No 377721 M C, male, age 30, was admitted to the Mount Sinai Hospital April 3, 1935 He had been a patient one week prior to the present admission At this time he had suffered an attack of upper abdominal pain with associated digestive disturbances He had never been frankly jaundiced although the icteric index was 16 The van den Bergh direct was delayed positive, and blood bilirubin 0 7 mg The gallbladder roentgenograms were negative The diagnosis upon discharge was cholelithiasis, chronic cholecystitis and possibly a common duct calculus with cholangeitis Six days after discharge from the hospital, he suddenly experienced another severe attack of sharp epigastric pain with nausea and vomiting During the attack, which lasted one day, he felt feverish but had no chills Upon his second admission, he was acutely ill and vomited bile stained material frequently The temperature was 100 2°F, pulse 96 The hemoglobin was 85 per cent The white blood count and differential were normal The urine contained a trace of bile The blood Wassermann was negative, and the blood chemistry normal There were distention and diffuse tenderness over the entire abdomen with the maximum tenderness localized in the right upper quadrant

The clinical impression was that the patient was suffering from either a penetrating

peptic ulcer, or an acute cholecystitis By midnight, on the day of admission, the abdominal pain had become excruciating, and temperature had risen to 103°F The entire abdomen was rigid Repeated abdominal punctures were negative, and roentgenologic examination failed to disclose the presence of air under the diaphragm, but showed some dilatation of the small bowel The patient's general condition gradually improved, the temperature subsided, and the abdomen became soft, although at times there were episodes of abdominal pain Stools were guaiac positive on one occasion At this time, the patient was noted to have a leucopenia The white count was about 4,000, 40 to 50 per cent lymphocytes The red blood cells appeared normal The fragility test was found to be increased above normal The blood amylase was 3 5, the icteric index, 11, van den Bergh direct was negative, and blood bilirubin 0 2 mg Duodenal drainage was performed and bile obtained, microscopic examination of which failed to reveal pus cells, bacteria or cholesterol crystals A gastro-intestinal series failed to show any evidence of abnormality Because of the persistence of the abdominal pain, and the inability to make a definite diagnosis, it was felt that surgical intervention was justified

Operation—May 1, 1935 Under spinal anesthesia, an upper right rectus muscle splitting incision was made The gallbladder was found to be markedly distended, and contained about 60 cc of dark green bile There were no stones It was adherent to the transverse colon and duodenum by innumerable adhesions The common duct appeared normal, as did the pancreas There were numerous recent adhesions in the lower abdomen suggestive of a peritonitis, and there was a chronically inflamed appendix About eight inches from the cecum, there was found a firm edematous, irregular mass in the ileum almost occluding the lumen at this point Proximal to this, for about 12 inches, the ileum was dilated and its walls markedly hypertrophied The mesentery of the diseased bowel was edematous, thickened and shortened The mesenteric nodes were enlarged and acutely inflamed The lesion was apparently that of terminal ileitis

A cholecystostomy was performed and the ileum was divided through an apparently normal bowel proximal to the lesion A side-to-side isoperistaltic ileotransverse colostomy was performed The postoperative course was complicated by a mild, nonsuppurative, left-sided parotitis, and a slight wound infection He was discharged May 17, 1935

The patient was last seen November 25, 1936 He had gained 12 pounds in weight and had no complaints Roentgenologic examination October 23, 1935, by means of a barium meal, showed nothing unusual

Case 3—No 372484 S K, male, age 27, was admitted to the surgical service of the Mount Sinai Hospital October 22, 1934 For the past five years he had been suffering from vague abdominal pains About one and one-half years ago these pains seemed to localize in the right lower quadrant, he was told he had a chronic appendicitis In April, 1924, the pain became more severe and colicky, and roentgenologic examination showed a lesion which was interpreted as a chronic ileal intussusception Since then he has had severe attacks of acute pain during which his abdomen became distended, and when seen in one of these episodes, peristalsis was visible

Physical Examination on October 2, 1934, revealed an emaciated young man who appeared chronically ill Examination of the abdomen revealed marked distention and visible peristalsis The hemoglobin was 90 per cent, red blood count 5,200,000, white blood count 29,000, polymorphonuclears 90 per cent The urine was negative

Operation—October 25, 1934 Under spinal anesthesia, through a lower right rectus splitting incision, a hard fibrotic mass occupying the ileum and covered by omentum was found about seven feet from the ileocecal junction Proximal to this there was a huge dilatation of the intestine with marked hypertrophy of its wall, the diameter of the ileum at this point measuring about five inches This fusiform dilatation extended orally for about 12 inches and its termination was marked by another fibrotic contraction The mesentery of the involved bowel was thickened and edematous with marked enlargement of the mesenteric nodes Beyond this segment the intestine appeared normal, al-

though the musculature appeared hypertrophic An examination of the remainder of the intestine revealed no further pathology

An intestinal resection of about two feet of diseased bowel was performed with a side-to-side ileo-ileal anastomosis The wound was closed in layers and without drainage The postoperative course was smooth The pathologic report was "regional ileitis of the ulcero-granulamatous type, with foreign body reaction and early fistula formation" The wound healed by primary union and the patient was discharged November 8, 1934

The patient was last seen April 27, 1937 He had gained ten pounds in weight and had no complaints His bowels moved once a day and were normal in consistency

Case 4—No 399413 S D, male, age 29, was admitted to the Surgical Service of the Mount Sinai Hospital October 7, 1936 During the past two months, he had become markedly constipated, and during this period there had been a loss of 35 pounds in weight, increasing weakness, anorexia, and occasional abdominal cramps, which began in the umbilical region and radiated to both lower quadrants A week before admission, he had a mild attack of diarrhea, but at no time were his stools bloody or tarry

Physical Examination disclosed a rather anemic, chronically ill male The general examination was negative, except that in the midline above the pubis there was an irregular, rather fixed mass the size of a lemon On rectal examination, there was felt a hard, irregular mass adherent to the anterior rectal wall which gave the impression of a malignancy of the rectosigmoid Proctoscopic examinations on several occasions, however, failed to reveal any pathology The patient left the hospital against advice, and was readmitted November 4, 1936, having spent several weeks in rest and forced feeding and had gained 11 pounds in weight He developed no new symptoms other than the occurrence of a slight dysuria and dribbling at the end of urination Roentgenologic examination showed no abnormality either in stomach, duodenum, small intestine or in the colon

Operation—November 4, 1936 Under spinal anesthesia, the abdomen was opened through a left para-umbilical muscle splitting incision The entire pelvis was found occupied by a large mass of matted small intestine adherent to the peritoneum over the sacrum, the base of the bladder, and to the sigmoid by firm, dense adhesions Upon liberating these, the matted mass of intestines was found to extend from the ileocecal junction proximally for two feet, the appearance was typical of regional ileitis The cecum appeared normal A typical ileocecal resection was performed, dividing the ileum through normal bowel and resecting about one-half of the ascending colon A side-to-side isoperistaltic ileosigmoidostomy was performed and the wound closed without drainage The pathologic report was chronic and acute ulcerative ileitis with conspicuous fibrosis and stenosis, ileo-ileal fistula, and chronic peritonitis with foreign body reaction The postoperative course was normal, except for a slight superficial wound infection, and he was discharged on the sixteenth day

The patient was seen April 15, 1937, at which time the wounds were healed The bowels were regular, moving three times a day

Case 5—No 400559 H C, male, age 37, was admitted to the Surgical Service of the Mount Sinai Hospital November 5, 1936 Eight years before, January 18, 1928, he had been operated upon at the hospital following a three weeks' history of abdominal pain, which, during the latter part of the illness, localized to the right lower quadrant At operation, a large mass, the size of a grapefruit, was found which consisted of cecum, appendix, terminal ileum, and an adherent loop of sigmoid The appendix which was acutely inflamed was found lying in the mesentery of the terminal ileum, which was almost two inches thick The appendix was removed and drainage instituted

Eight months after discharge, the abdominal wound, which had closed completely, again began to drain gravish fluid and continued to do so for a period of two months, when it healed spontaneously Two years later, May 5, 1931, he entered the hospital for an abdominal wall abscess in the region of the scar This was incised and a fistulous tract found, which, after lipiodol injection, was seen to lead down to the region of the cecum,

the lipiodol entering the cecum and the ascending colon The fecal drainage ceased and patient was discharged, only to return five months later with a fecal fistula Because of the induration and inflammatory reaction about the sinus, he was advised to return after this had subsided for operative intervention

Operation—October 30, 1931 There were extensive adhesions binding the small intestine and cecum to each other and to the anterior abdominal wall The fistulous tract was found leading down, not to the cecum but to the terminal ileum, about two inches from the ileocecal junction A mass was felt in the ileocecal region which was found to be for the most part thickened, indurated, edematous and hyperplastic ileum, extending about 30 cm from the ileocecal junction The cecum and ascending colon appeared grossly free, except just at the region of the ileocecal valve About 40 cm of ileum, cecum and 10 cm of ascending colon were resected, and a side-to-side ileotransverse colostomy performed Drains were placed in lumbar gutter The pathologic report was "hyperplastic granuloma of the terminal ileum with fistula"

The postoperative course was quite uneventful He was discharged on the eighteenth postoperative day, November 22, 1931, with the wound healed Since his discharge from the hospital five years ago, he has been observed every six months in the Surgical Follow-Up Clinic He has felt perfectly well with the exception of occasional pain in the abdomen The bowel movements have been watery, but contained neither blood nor pus and were never more than three a day His appetite is good and there has been no weight loss On his last visit to the Follow-Up Clinic three months ago, he complained of increasing pain in the abdomen, and a gastro-intestinal series showed a narrowing of the lumen at the part of the bowel in the region of the anastomosis, typical of terminal ileitis He was advised to enter hospital for operation

Operation—November 7, 1936 Under spinal anesthesia, the abdomen was opened through a left para-umbilical rectus muscle splitting incision The previous ileocolostomy stoma was found without difficulty The colonic portion of stoma was soft and appeared normal Eighteen inches of the previously anastomosed terminal ileum showed the characteristic lesions of so called regional ileitis The intestine was enlarged and indurated, the surface was dull, and had a leathery feel There was no evidence of either stricture or fistula formation The mesentery was markedly thickened, shortened, and edematous The lymph nodes showed definite hypertrophy Beyond this 18 inches of terminal ileum, the bowel appeared normal The normal ileum was divided two feet from the ileotransverse colostomy together with its mesentery, and the proximal portion of the ileum, after both ileal ends had been closed, was anastomosed to the sigmoid by a side-to-side isoperistaltic ileosigmoidostomy The wound was closed in layers without drainage

Following operation, patient made an uneventful recovery and was allowed up on the tenth postoperative day At present, he has two bowel movements a day, which are slightly watery in consistency

The patient was again seen January 21, 1937, at which time he had gained seven pounds in weight He was having three bowel movements a day, the consistency of which was gradually becoming thicker

Case 6—No 378320 C W, male, age 16, was admitted to the Surgical Service of the Mount Sinai Hospital April 1, 1935 He had been in this hospital a year previously with lobar pneumonia He had been perfectly well until three months before admission, when he began to experience diarrhea and tenesmus For three months, he had had transient pain in the right lower quadrant, usually unrelated to meals or bowel movements He had been treated in the Out-Patient Department where the diarrhea had been moderately controlled He had lost 15 pounds in weight in three months

Physical Examination—He appeared asthenic and somewhat emaciated There was moderate tenderness and slight rebound tenderness in the right lower quadrant and no palpable masses Rectal examination revealed slight tenderness on the right Hemoglobin 72 per cent, white blood count 19,600, polymorphonuclears 72 per cent Temperature 101° F The stool was guaiac-positive and showed many red blood cells and

white blood cells on microscopic examination The blood Wassermann was negative The blood agglutinations for dysentery were negative, stool culture yielded only *B coli* and enterococcus Sigmoidoscopy revealed a very finely granular mucosa in a few spots, but for the most part the only abnormality noted was a moderate congestion It was considered that these represented only minimal lesions of a possible mild ulcerative colitis Barium enema revealed an irregular constricting lesion of both the ascending colon and hepatic flexure, markedly obstructing the passage of barium Because of obstruction, it was not possible to fill the cecum completely, but the impression was gained that there was also a narrowing of the cecum and spasm and perhaps some narrowing of the terminal ileum A few diverticula of the descending colon were noted

The patient ran a persistently low grade febrile course In the right lower quadrant, a small tender sausage-like mass gradually became more noticeable Because of nonbloody diarrhea, palpable mass, and right lower quadrant pain and tenderness, it was felt that there was probably present a localized granuloma rather than an ulcerative colitis The von Pirquet test was negative, but, nevertheless, the possibility of a hypertrophic tuberculosis of the large intestine could not be excluded Examination of concentrated stool was negative for tubercle bacilli

Operation—April 20, 1935 Under spinal anesthesia, Dr Leon Ginzburg performed a celiotomy through a four inch left rectus incision The terminal ileum appeared normal, but the cecum and ascending colon were the seat of extensive inflammatory disease and were covered over by omental adhesions No formal exposure of these areas was attempted The ileum was divided about six inches from the ileocecal junction, and a side-to-side ileosigmoidostomy was performed Following operation, patient ran an uneventful course and was discharged

Since discharge, the patient's improvement has been amazing When last seen, November 25, 1936, he had gained 30 pounds in weight, and the mass palpable in the abdomen before operation could hardly be felt He was symptom free Bowels are regular, once a day, and normal in appearance Roentgenologic examination showed evidence of the ileotransverse colostomy The proximal half of the colon filled fairly well The barium, as it filled the colon, proceeded so rapidly that it was impossible to see the stoma clearly After evacuation the cecum and the ascending colon were seen and appeared somewhat narrowed, but there was no evidence of a mass in the lumen of the cecum The part of the ileum visualized showed no definite abnormality

REFERENCE

[1] Crohn, B B, Ginzburg, L, and Oppenheimer, G D Nonspecific Granulomata of the Intestines ANNALS OF SURGERY, 98, 1046, December, 1933

DISCUSSION—DR HENRY W CAVE (New York) cited what he believed to be a rather unusual case of terminal ileitis operated upon by him some years ago He presented it for the reason that the specimen shows rather discrete granulomatous areas appearing almost like ulcerations in the terminal ileum with one large encircling, constricting, granulomatous involvement The patient was a man, age 31, who came to the hospital complaining of symptoms of acute intestinal obstruction, and a very rapid loss of weight For the past three and one-half months he had passed considerable amounts of blood and mucus by rectum At operation a thickened terminal ileum with granulomatous ulcerations was found Doctor McCallum, who at that time was pathologist of the College of Physicians and Surgeons, was interested in this specimen He made cultures and sections and finally came to a diagnosis of what he called a chronic ulcerative infectious granuloma of the terminal ileum

DR RALPH COLP (New York) closing said In regard to Doctor Cave's mention of the fact that the divided sigmoid is rather difficult to close, espe-

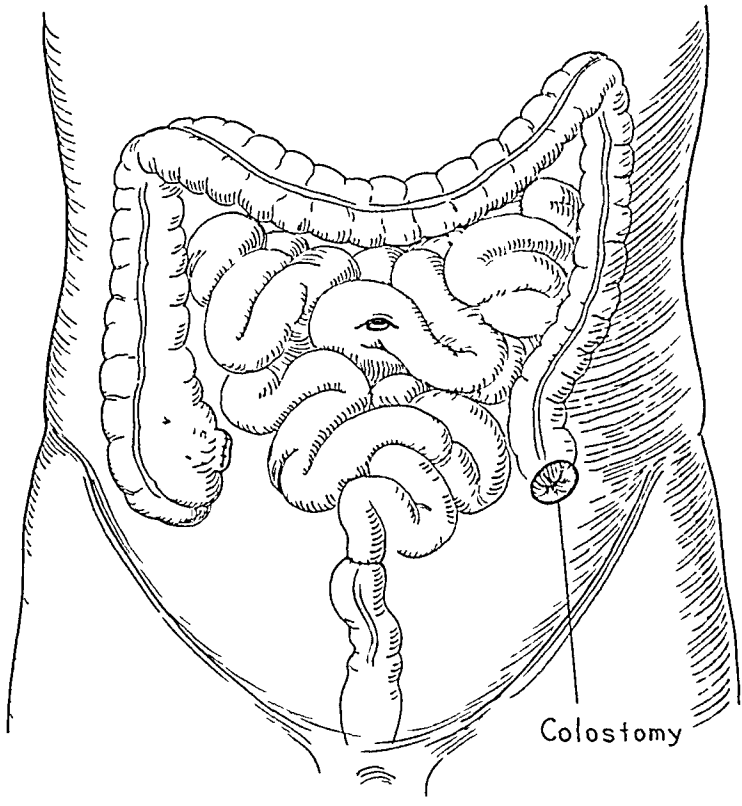


FIG 1.—The von Beck operation for colonic exclusion in cases of ulcerative colitis

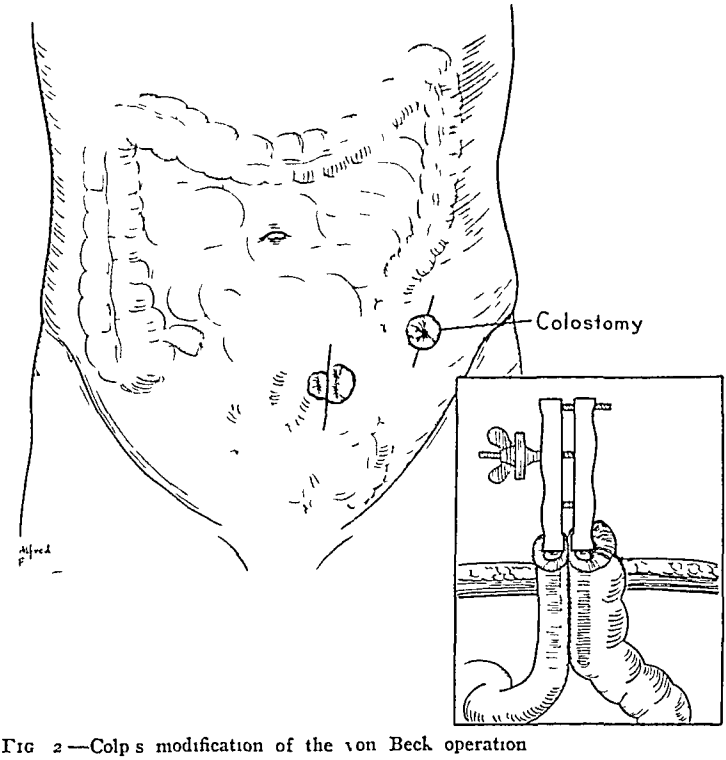


FIG 2.—Colp's modification of the von Beck operation

cially in cases of ulcerative colitis in which the rectum is not particularly involved, von Beck,[1] in 1913, reported an operation in cases of ulcerative colitis in which he divided the ileum near the ileocecal junction, and the colon at the sigmoid The terminal ileum was closed and the proximal loop of colon was brought out as a colostomy, thus isolating the colon He then recommended the anastomosis of the proximal ileum to the distal segment of the sigmoid by end-to-end suture (Fig 1) Doctor Colp said the teaching in the past had been that intraperitoneal anastomoses are rather dangerous and should be avoided whenever possible In a recent case, however, he had employed a procedure similar to the von Beck operation, but with modifications The ileum was divided and the proximal colon was brought out as a colostomy, thus isolating the colon Then he brought the proximal ileum out, through a left rectus incision, as an ileostomy, and the distal portion of the sigmoid out as a sigmoidostomy, approximating the intraperitoneal portion of both loops by interrupted serosal sutures (Fig 2) The sigmoid and rectum are put at rest for any desired period, and, if multiple polypi are present, a sigomidoscope may be introduced through the rectum and through the sigmoidostomy, and any polypi which may be present may be fulgurated At some future time, provided the general condition of the patient is satisfactory, the spur between the ileum and sigmoid may be crushed, and an extraperitoneal closure performed In that way the danger of intraperitoneal leakage is avoided The isolated colon may then be removed, if necessary

REFERENCE

[1] Beck, Berhard von Beitrage zur Klinische Chirurgie, 84, 339–343, 1913

THE SO-CALLED HEPATO-RENAL SYNDROME

JOHN H GARLOCK, M D , AND SAMUEL H KLLIN, M D
NEW YORK, N Y

FROM THE SURGICAL SERVICE OF THE MT SINAI HOSPITAL NEW YORK

SINCE 1924, when Heyd[24 25] called attention to the unusual postoperative course pursued by some patients after gallbladder surgery, there have appeared many articles on this subject, a careful analysis of which indicates that a few important points have been presented by three or four contributors and that most of the remaining articles contain confirmatory experiences by their authors

It will be remembered that Heyd in his original and subsequent papers[24 to 29] described a series of postoperative complications other than those which may reasonably be expected, as, for instance, hemorrhage, shock, gastric dilatation and embolism in the first 24 hours and infection resulting in peritonitis or abscess formation in the succeeding 48 to 72 hours He divided these unusual cases into three clinical groups

Group I —After a simple cholecystectomy in a patient in good general condition and whose preoperative studies have indicated competent renal, cardiac and respiratory function, recovery from the anesthetic is unduly delayed The patient remains semicomatose for four to six hours, develops a talking delirium, subsultus tendinum, rapidly passes into coma with high temperature and dies

Group II —In this group, the patients have had a rather severe form of biliary infection with a history of jaundice and possibly a previous gallbladder operation Following a choledochotomy with common duct drainage, the postoperative progress seems satisfactory for 36 to 48 hours The patient then becomes irritable and nervous and passes into a pronounced vasomotor collapse with cold clammy extremities, and death finally supervenes This clinical course was noted by Heyd in spite of a definitely diminishing jaundice and ample renal function He considered these cases to be due to the liberation of some pancreatic toxins with inadequate liver protection These patients did not exhibit alkalosis as did some in Group I

Group III —In a series of patients admitted with a clinical picture of calculus cholangeitis, pancreatitis or, rarely, carcinoma of the head of the pancreas, operation was undertaken for the relief of these conditions and included, often, the institution of biliary drainage, either externally, or internally by cholecystogastrostomy The immediate postoperative course seemed satisfactory Icterus diminished appreciably and dehydration was overcome If external biliary drainage was utilized, the patient was refed his own bile After five or six days, in the presence of a constantly diminishing jaundice,

Submitted for publication March 23, 1937

these patients became somnolent, and soon passed into a state of coma which ended in death

Heyd excluded infection as the cause of the syndrome presented in Group III, although his articles contain little mention of autopsy findings He presented the theory that an increased burden was thrown on an already compromised liver of detoxifying a further increment of poisonous products and that the liver was unable to perform this function, resulting in a progressive exhaustion of liver capacity In support of this view, he quoted Graham's[17] work which stressed the frequent association of disease of the gallbladder and definite evidence of hepatitis May we, at this time, call attention to the paper of Colp, Doubilet and Gerber[10] whose findings are at some variance with those of Graham They performed liver biopsies in 49 cases of acute and chronic cholecystitis with and without jaundice Studies with finer histologic technic revealed no changes in the liver cells in biliary tract disease without jaundice Focal liver cell degeneration seen in cases with jaundice represented, in their opinion, a reaction to bile stasis and was in no way related to the primary disease of the gallbladder They believe that the periportal infiltrations observed in biliary tract disease are not specific of the disease but represent a reaction of the liver to extrahepatic infection They conclude that hepatitis is not an accompaniment of cholecystitis as evidenced by the absence of inflammatory and parenchymal changes in the liver

Heyd's observations aroused considerable discussion and there soon appeared a series of communications which more or less corroborated his clinical findings Boyce and McFetridge[3 to 7] feel that the so-called "liver deaths' after biliary surgery fall into two distinct groups

Group I—Death occurs shortly after operation with hyperpyrexia as the outstanding symptom and degenerative changes in the liver the only positive finding at autopsy

Group II—Death is deferred for 10 to 14 days when uremic symptoms predominate and postmortem examination reveals the degenerative liver damage plus similar degenerative changes in the convoluted tubules of the kidneys

They attempted to reproduce these clinical syndromes experimentally, but were successful with Group II only Using dogs, they ligated the common duct and maintained the obstruction for 18 days Following release of the obstruction, the clinical picture presented by the cases in Group II was reproduced Urinalysis and blood chemistry revealed the changes characteristic of an acute renal insufficiency All the animals died in uremic coma and autopsy revealed the degenerative changes in the liver and kidneys seen in humans

These authors contend that the release of the biliary obstruction rather than the obstruction itself is responsible for the fatal outcome in some cases of biliary surgery The hepatic changes present in biliary disease are aggravated in some cases by the surgery instituted to relieve it, which imposes upon an already damaged liver an intolerable burden This includes anesthesia, surgical trauma, a drop in intra-abdominal temperature and changes in intra-

hepatic and biliary pressure They state that, as a result of the degenerative hepatic changes, seen also in cases of liver injury, hyperthyroidism, intestinal obstruction and burns, there is released into the circulation a toxic substance which is presumed to be a water-soluble foreign protein When, after liver function fails, the kidneys take up the function of detoxification, there is resulting damage to their convoluted tubules, through which foreign proteins are excreted These authors conclude that the hepato-renal syndrome is a single pathologic process of which the kidney disturbance represents the second stage In view of the fact that most of these cases must, by inference, have a considerable degree of impairment of hepatic function these authors suggest preoperative renal function tests as an indication of liver function with the hope that these tests may actually reflect the efficiency of the liver The same suggestion was made by Wilensky and Colp,[11] in 1927

On the other hand, the observations of Helwig and Schutz[10] are worthy of note In those cases coming to autopsy they were struck with the fact that most of the definite pathologic findings were confined to the liver and kidneys The liver usually appeared enlarged, presented fatty degeneration, cloudy swelling and polymorphonuclear leukocytic infiltrations with focal hemorrhages and parenchymatous cell necrosis The kidneys were usually enlarged Histologically, there was evident necrosis of the tubular epithelium On the basis of the clinical course of a patient who received a laceration of the liver in an automobile accident and who developed symptoms identical with those under discussion and, also, because of the report of a similar instance of liver trauma by Furtwaengler, Helwig and Schutz conducted a series of experiments on dogs which consisted essentially of pulpification of most of the liver Those animals that died within 12 hours from hemorrhage and shock were found to have albumin, casts and red blood cells in the urine Those that survived the operation showed a rise in blood nitrogen, albumin, casts and red blood cells in the urine and progressive oliguria In the first group, autopsy disclosed degeneration of the kidney epithelium and hemorrhagic necrosis of the liver In another series of experiments, the same results were obtained by ligation of the hepatic artery which caused primarily a liver necrosis

The clinical behavior in these traumatic cases and their similarity both clinically and at necropsy, to those described by Heyd and others have led these authors to assume that liver damage, whether traumatic or infectious in origin, produces a selective toxin which may severely damage the kidneys In view of the fact that this syndrome has always followed damage to the liver and has occurred in individuals with previously normal kidneys (determined by kidney function tests), they believe that the pathologic changes in the kidney are secondary to the liver changes and are dependent upon a specific toxin elaborated in the course of liver cell destruction

Our interest in this mysterious syndrome was recently intensified by the clinical course and subsequent pathologic studies of a patient who was operated upon for calculus gallbladder and bile duct disease We believe that this case is of considerable importance First, because of the careful studies conducted

both before and after operation, and second, because the autopsy findings are at such variance with those reported in the literature on the subject

Case Report—Hosp No 375648 R B, white, female, married, age 54, was admitted to the Mt Sinai Hospital January 14, 1935 Her personal, family, and past histories were irrelevant Her present illness began two years before admission, with pain in the right upper quadrant which radiated around to the back The pain was always related to the ingestion of fatty foods These symptoms occurred only rarely after a self-imposed fat restricted diet During the period of her present illness she had lost 30 pounds in weight She also suffered from generalized pruritis and was told she was a diabetic During the year prior to admission, and especially in the latter half, she experienced frequent attacks of abdominal pain associated with jaundice, fever, and occasional chills The last episode of jaundice occurred one week before admission to the hospital At no time was the jaundice pronounced With the subsidence of the pain the jaundice rapidly disappeared

Physical Examination disclosed a moderately obese woman whose skin presented a yellowish color The conjunctivae and sclerae, however, were not icteric There was a herpes simplex on the upper lip Her heart and lungs were negative The abdomen was soft not distended There was tenderness in the right upper quadrant and epigastrium, and a mass which was thought to be gallbladder was palpable as far as the umbilical line There was no evidence of ascites Oral cholecystography failed to visualize the gallbladder No evidences of gallstones were seen The clinical diagnosis on admission was chronic cholecystitis and cholelithiasis with hydrops of the gallbladder

Laboratory Data Hemoglobin 90 per cent, white blood cells 9,000, of which 68 per cent were polymorphonuclear neutrophiles, 26 per cent lymphocytes, 4 per cent monocytes, and 2 per cent eosinophiles The blood smear appeared normal The stools were colored and contained bile and urobilin Guaiac test for occult blood was faintly positive The urine was always negative for sugar, acetone, and diacetic acid The specific gravity varied from 1016 to 1020 albumin negative Microscopic examination negative On three occasions before operation, bile in the urine was reported 1 plus Urobilin on four occasions was present 1 20 The Janney test for glucose tolerance evoked a normal response The blood Wassermann was negative Blood chemistry studies revealed the following

Urea nitrogen	9 mg per 100 cc
Sugar	110 mg per 100 cc
Cholesterol	275 mg per 100 cc
Cholesterol ester	145 mg per 100 cc
Icteric index	15
van den Bergh	direct—faint delayed positive, indirect—1 250,000, Mg 0 4

The electrocardiogram showed no definite abnormality Blood pressure 100/64

Operation January 22, 1935, eight days after admission (T H G) Spinal anesthesia was employed, using 120 mg of neocaine An upper right rectus incision was made Some difficulty was encountered in entering the peritoneal cavity because of rather extensive adhesions The great omentum was adherent to the parietal peritoneum The liver edge was obliterated by adhesions which anchored it to the costal margin After combined blunt and sharp dissection, the stomach, duodenum, and colon were finally separated from the under surface of the liver The latter structure was freed from the costal margin The liver was slightly enlarged, normal in appearance, with a slightly rounded anterior edge The gallbladder was small and shrunken and contained a few stones Further exploration showed an unusual condition of the common and hepatic ducts The duct system, which was easily brought to view through its entire extent, was found to be enormously dilated The common duct was fully two inches in diameter Each hepatic duct measured about one inch in diameter The entire common duct down to the ampulla of Vater and both hepatic ducts as far as their tertiary divisions were

filled with biliary calculi A vertical incision was made in the common duct about two inches above the duodenum and through which 48 calculi of various sizes and shapes were removed The duct system was irrigated A free flow of yellow bile followed the removal of the calculi A subserous cholecystectomy was performed The liver bed was sewn over A No 22 French catheter was placed in the common duct and the remainder of the incision in the duct sutured snugly around the tube Two cigarette drains were placed down to Morrison's pouch and the wound closed in layers Time of operation One hour and five minutes

Postoperative Course There was no variation in the blood pressure postoperatively



FIG 1.—Roentgenogram (lateral view) made after the injection of lipiodol through the choledochostomy showing the enormous dilatation of the bile ducts

First Postoperative Day Hemoglobin, 93 per cent Temperature, 101 2° F Patient comfortable No distention Profuse drainage of bile through common duct tube

Second Postoperative Day Urine negative for bile and urobilin Icteric index, 20 van den Bergh direct—prompt positive Indirect—1 100,000 Mg 1 0

Third Postoperative Day Urine negative for bile Urobilin 1 10 Roentgenologic examination was made after injection of lipiodol into the common duct drainage tube This showed the biliary radicals to be irregularly outlined There was marked dilatation of the hepatic and common ducts (Fig 1) No evidence of obstruction and nothing to suggest the presence of stones Temperature 101 8° F Wound clean No cough or chest pain Abdomen soft Condition excellent

Fourth Postoperative Day Roentgenologic examination 24 hours after the lipiodol injection showed a small amount of opaque material still present in the biliary system The common duct was completely empty

Fifth Postoperative Day It was noted that the patient presented marked asthenia Had drained about 15 ounces of bile daily since operation The asthenia was thought to be due to long standing chronic prancreatic and intermittent biliary obstruction plus the recent loss of bile and pancreatic ferments through the common duct tube For this reason the refeeding of the drained bile was instituted This was continued until two days before death The wound appeared clean Blood count white blood cells, 14,650, polymorphonuclear leukocytes, 72 per cent, lymphocytes, 10 per cent, monocytes, 16 per cent, eosinophiles, 1 per cent, basophiles, 1 per cent

Sixth Postoperative Day Temperature, 100 4° F Wound edges reddened and puffed The skin sutures were removed and about one ounce of thick sanguinopurulent material was evacuated from the upper and lower angles A smear of this material showed a moderate amount of pus cells and debris, but no organisms The culture, however, revealed *B coli*, enterococcus and *Staphylococcus albus* The chest was clear, the abdomen was soft and not distended Marked asthenia persisted Bile was being refed by mouth Hemoglobin, 75 per cent, blood pressure, 100/72 Patient was given a transfusion of 500 cc by the citrate method

Seventh Postoperative Day Hemoglobin, 90 per cent, white blood cells, 15,900, 90 per cent polymorphonuclear leukocytes, lymphocytes, 4 per cent, monocytes, 6 per cent Urine, bile negative, urobilin 1 5

Eighth Postoperative Day Patient appeared profoundly asthenic Eyes sunken, conjunctivae injected, voice subdued and monotonous, and reaction to stimuli sluggish, beginning to ooze blood from the wound There was no icterus The clinical condition was ascribed to either hepatic or pancreatic insufficiency However, because of apparent tenderness on pressure over the right lower chest near the axillary region, the possibility of a subphrenic infection or an abscess of the liver was considered Consequently, aspiration was performed Liver blood was obtained, which was negative upon culture Because of the oozing of blood from the wound, the packing was removed to facilitate investigation The wound surfaces were found separated down to the peritoneum with hemorrhage coming from several small vessels and oozing from the entire wound surface The vessels were ligated and the wound was packed Urine was negative for sugar, acetone and bile Blood calcium 9 7 mg per 100 cc Hemoglobin 72 per cent Patient given 500 cc of blood by the citrate method Blood urea nitrogen 69 mg per 100 cc

Ninth Postoperative Day Blood urea nitrogen rose to 105 mg per 100 cc Urine, cloudy, acid, sp gr, 1018, albumin 2 plus, sugar and bile negative, urobilin present in 1 5 dilution Hemoglobin 88 per cent, white blood cells 28,000, 88 per cent polymorphonuclear neutrophiles, and 8 per cent lymphocytes General condition seemed slightly improved

Tenth Postoperative Day Urine, cloudy, acid, sp gr, 1010, albumin 1 plus Microscopic examination showed a few white blood cells, very few red blood cells, and epithelial cells Culture of urine revealed *B* coli and the enterococcus The biliary drainage which was still profuse, was slightly positive for diastase and trypsin Blood chemistry determinations were as follows

Cholesterol	200	mg per 100 cc
Cholesterol ester	105	mg per 100 cc
Total protein	6 4%	
Albumin	3 9%	
Globulin	2 5%	
Carbon dioxide	44	volumes per cent
Urea nitrogen	76	mg per 100 cc
Sugar	195	mg per 100 cc
Chlorides	535	mg per 100 cc
Uric acid	4 0	mg per 100 cc
Creatinine	3 5	mg per 100 cc
Icteric index	17	

Eleventh Postoperative Day Patient's condition became grave Seemed stuporous and could be aroused only with great difficulty Pulse weak and rapid Blood pressure 90/60 The course was progressively down hill Several foci of local infection were now present (1) The wound, (2) a gangrenous patch on the anterior wall of the vagina, (3) a right parotitis Blood culture, negative Hemoglobin, 88 per cent, red blood cells, 4 810,000, platelets 240,000, white blood cells, 38,700, polymorphonuclear neutrophiles, 85 per cent, of which there were 15 per cent with segmented nuclei and 70 per cent non-segmented, lymphocytes, 6 per cent, monocytes, 9 per cent, reticulocytes, 0 5 per cent Blood volume studies

Relative cell volume	38%
Serum volume	3,500 cc
Cell volume	2,140 cc
Total blood volume	5,640 cc
Blood volume per kilo	85 cc

She had been receiving liver extract intramuscularly, two cubic centimeters twice daily

Twelfth Postoperative Day Urine, sp gr, 1012, albumin 2 plus, bile negative, urobilin 1 20, occasional erythrocytes and clumps of leukocytes seen microscopically Blood urea 90 mg per 100 cc, cholesterol 180 mg, serum calcium 9 6 mg, chlorides 510 mg Stool examination, tan color, urobilin present Guaiac test positive for occult blood Icteric index 30 A note by the medical consultant read "From the history and the operative findings, there is every reason to believe that this patient had a very badly damaged liver parenchyma before operation I believe that the postoperative asthenia is probably due largely to liver insufficiency, perhaps combined with pancreatic insufficiency, and that the nitrogen retention is the result of the prolonged low blood pressure The blood pressure at the time of examination was 74/46, just barely sufficient to maintain a minimal amount of kidney function"

Thirteenth Postoperative Day Blood chemistry

Urea nitrogen	114	mg per 100 cc
Creatinine	3	mg per 100 cc
Cholesterol	160	mg per 100 cc
Calcium	8 7	mg per 100 cc
Phosphorus	3 9	mg per 100 cc
Chlorides	575	mg per 100 cc
Carbon dioxide	34 5	volumes per cent
Total protein	5 6%	
Albumin	3 4%	
Globulin	2 2%	
Icteric index	30	
van den Bergh	direct—Prompt positive, indirect—1 60,000, mg 1 5	

Oozing from the wound continued from the eighth postoperative day Tonight patient had a profuse epistaxis Pulse gradually became weaker and the patient died with a terminal temperature of 107 4° F (Table I)

Postmortem Examination The body was that of a pale, well-developed, well-nourished female of 54 The skin was light yellow, but the sclerae were not icteric An incision into the subcutaneous tissues in the left upper margin of the wound disclosed white turbid fluid exuding from the fat The peritoneum was everywhere smooth and glistening There was no free fluid in the abdominal cavity Several small areas of bronchopneumonia were present in the left lower lobe There was a small blackish-red ulcer on the anterior vaginal wall just inside the labia minora The stomach was dilated and filled with a large amount of bloody fluid The gastric mucosa was pink and congested On the anterior

TABLE I

SUMMARY OF THE POSTOPERATIVE TEMPERATURE, PULSE, BILIARY DRAINAGE, FLUID INTAKE AND URINARY OUTPUT

Date	Pulse	Temperature	Urinary Output	Biliary Drainage	Fluid Intake By Mouth	Fluid Intake Intravenous
Jan 22 (oper.)	88	100° F		12 ounces	54 ounces	
Jan 23 (1st p.o. day)	100	102° F	33 ounces	10 "	65 "	
Jan 24	110	101° F	57 "	10 "	72 "	
Jan 25	100	101 6° F	65 "	10 "	58 "	
Jan 26	100	101° F	38 "	7 "	80 "	
Jan 27	100	100 8° F	48 "	10 "	74 "	
Jan 28	112	100 4° F	30 "	5 "	42 "	
Jan 29	104	100 2° F	22 "	4 "	40 "	
Jan 30	122	102 8° F	Incontinent	3 "	Nothing p.o.	10 ounces
Jan 31	130	Chill 106 8° F	"	10 ounces	38 "	25 "
Feb 1	126	101 2° to 104 2° F	"	Profuse	40 "	96 "
Feb 2	120	104° F	14 ounces	?	4 "	71 5 "
Feb 3	120	104° F	18 "	?		58 3 "
Feb 4	120–160	Died 107 4° F		?		

wall near the lesser curvature was a small superficial erosion 0 5 cm long There were also many tiny homogeneous red areas The duodenum, small intestine, colon and rectum were congested and filled with bloody contents The pancreas was moderately fatty The pancreatic duct was slightly dilated and opened into the common duct 1 Mm above the papilla of Vater

The liver weighed 2,165 Gm The anterior and superior surfaces were adherent to the diaphragm The capsule was covered by fibrous adhesions The organ was firm and its inferior edge was sharp On section, the surface was pale and grayish-green The lobular structure could be identified The bile ducts in the larger portal fields were thickened and contained turbid yellow-brown bile On the anterior surface of the liver in the region of the gallbladder fossa there was a white cylindrical prominence, which, on section, was found to be a thick-walled channel filled with turbid milky fluid This channel was found to communicate with the bile ducts The gallbladder fossa was clean In the floor of the walled-off drainage tract a longitudinal opening into the common duct was present The common bile duct was distended to 2 cm in diameter and contained a small amount of bloody mucus The mucosa was thickened and red The duct opened into the duodenum by a patent orifice The common bile duct, traced upward, was distended throughout and became continuous with the two distended, thickened, congested hepatic ducts The intrahepatic bile ducts were dilated throughout There were no stones in any of the biliary ducts

The kidneys weighed 360 Gm together They were of equal size and flabby The capsules stripped with ease, leaving a smooth grayish-yellow surface The cut surface presented a somewhat widened cortex which was jaundiced The markings within it were fairly well delineated The corticomedullary demarcation was sharp The pelves were congested The ureters were narrow and pale The renal arteries and veins were smooth and clear

Microscopic Examination—Kidneys The capsule was thin The general architecture of the kidney appeared unchanged The convoluted tubules of the cortex were, in general,

of normal size and width In some areas, they were closely approximated, in other places, however, they appeared separated by a widening of the intertubular stroma which was spongy and frequently infiltrated with lymphocytes, occasional polymorphonuclear leukocytes and rare plasma cells The intertubular capillaries, for the most part, contained few red blood cells, in places, however, they were congested The walls of the interlobular arteries were normal The afferent arterioles occasionally showed slight hyalinization The lumen of the convoluted tubules frequently contained granular masses, occasionally desquamated epithelial cells The epithelial lining of the convoluted tubules did not show striking changes However, on close examination, one quite frequently found the epithelial cells vacuolated, with occasional loss of nuclei Some of them contained yellowish-brown material, which was apparently bile pigment Some of the tubules presented a flattened epithelium, and such tubules contained a few polymorphonuclear leukocytes Only rarely were tubules found where the epithelium showed more severe degenerative changes, such as hyaline droplet degeneration

The majority of the glomeruli were well preserved, only a very few were fibrotic

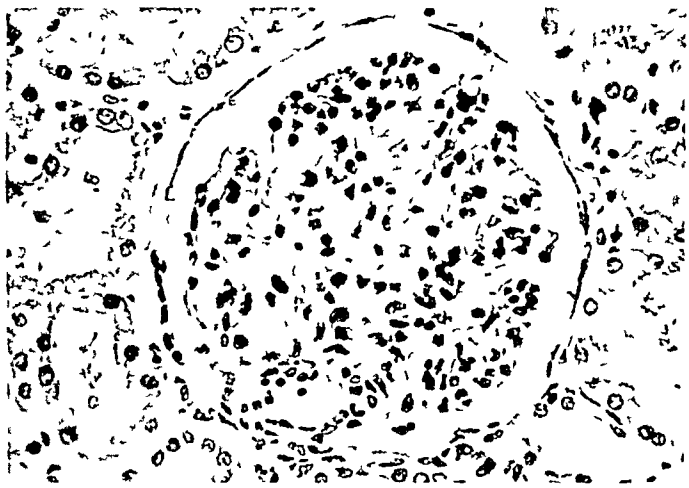


FIG 2—Photomicrograph of section from the kidney The glomerulus is enlarged and the intercapillary stroma is prominent and spongy as if distended with fluid

In the vicinity of such fibrotic glomeruli the tubules were atrophic, the stroma increased and infiltrated with lymphocytes Most of the glomeruli were strikingly large Their capsules were not thickened, the parietal epithelial cells were flattened, in general, Bowman's space was empty In spite of the striking size of the malpighian corpuscles, there was no increase in their cellularity The covering epithelial cells of the tufts were not enlarged, neither were the endothelial cells unduly prominent The capillaries contained a normal amount of red blood cells and only occasional leukocytes The intercapillary connective tissue framework (Zimmermann[4]) was prominent and it appeared spongy, as if distended by fluid (Fig 2)

The medulla of the kidney showed frequent nests of lymphocytes, plasma cells and infrequent polymorphonuclear leukocytes within the stroma The Henle's loops contained inspissated homogeneous material and occasional leukocytes Bile stained casts were seen and occasional granular and hyaline cylinders Very infrequently, round calcified masses were noted enclosed within the lumen In one area where the medulla bordered on the peripelvic connective tissue and fat tissue there was a hemorrhage, and some of the adjacent tubules contained blood One section showed a large hemorrhage beneath the pelvic epithelium extending into the peripelvic fat tissue Around this hemorrhage there was considerable infiltration with polymorphonuclear leukocytes

Liver The capsule was thin The lobular structure was distinct and intact The

periportal connective tissue seemed markedly increased The central veins contained but little blood The liver cells about the central veins appeared somewhat shrunken and contained some yellowish-brown granular pigment The sinus walls and Kupffer cells were separated from the liver cords, forming appreciable Disse spaces The latter contained much granular debris, rarely a red blood cell In places, large amounts of bile pigment were contained within vacuolated, swollen, or shrunken liver cells, surrounded or compressed by fibrous tissue from the portal fields The latter were much enlarged by fibrous tissue and infiltration with inflammatory cells consisting mainly of lymphocytes, some plasma cells and polymorphonuclear leukocytes (Fig 3) The bile ducts within the portal fields were increased in number In some of the bile ducts there were polymorphonuclear leukocytes between the epithelial cells The portal veins and hepatic artery presented no changes A section of a large bile duct slightly removed from the region of the hilus showed an edematous wall and infiltration by numerous polymorphonuclear leukocytes, eosinophiles, active phagocytes, and fibroblasts There was hemorrhage into some of the



FIG 3 —Photomicrograph of section from the liver showing acute and chronic cholangeitis

liver cords abutting upon this duct and some hemorrhage into the wall of the duct There was much bile pigment in the cells about the portal fields Throughout the sections, there was no evidence of liver cell necrosis

SUMMARY The liver showed the pathologic picture of an acute and chronic cholangeitis and cholangeiolitis with icterus There was no evidence of severe parenchymal damage

The kidneys showed focal interstitial inflammation and edema There was, however, no evidence of severe degenerative change in the tubular epithelium, but there was a striking glomerular lesion

Anatomic Diagnosis Acute and chronic cholangeitis Acute intercapillary glomerulonephritis (MacCallum[32]) Jaundice (slight) Gastric erosions Vaginal ulcer Bronchopneumonia, left lower lobe Pulmonary edema and congestion Mild parenchymatous degeneration of the liver, heart and kidneys Acute congestion of the spleen Fibrous pleural adhesions

Discussion Concerning the cases in Group I of Heyd's classification, namely, those characterized by hyperpyrexia and death within 48 hours of operation, considerable disagreement and controversy already exist Thus,

Touroff,[38] in a recent communication, is rightfully cautious against entertaining a diagnosis of "liver shock," unless there has been a corroborative complete postmortem examination He reviewed a series of cases from the Mt Sinai Hospital that were subjected to simple cholecystectomy with drainage The patients were neither jaundiced nor acutely ill at the time of the operation and had not been subjected to any previous operative procedure on the biliary tract Without apparent cause, they developed the classic picture of rapidly rising temperature, shock and early death In a number of instances, the clinical diagnosis of "liver shock" was entertained, yet careful postmortem examination revealed a previously unrecognized intra-abdominal or pulmonary infection to explain the whole picture

On the other hand, the experiences of the senior author (J H G) 12 or 13 years ago at the old New York Hospital came to mind and those records were recently reviewed in order to corroborate the impression gained at that time On the Second Surgical Division, in those days, many cases of acute cholecystitis were treated as emergencies, as is being advocated by a number of surgeons at the present time A group of the patients so treated developed the typical picture under discussion and died within 48 hours with hyperpyrexia as the outstanding symptom Yet, careful postmortem examination, in two instances, failed to reveal the cause of death There was not the slightest evidence of infection and the liver sections showed only occasional periportal accumulations of polymorphonuclear leukocytes These cases were disconcertingly puzzling at the time and the thought was entertained that a profound physiologic or chemical change had taken place which could not be determined by any known clinical or laboratory methods Since then, as far as we know, nothing of any importance has developed to throw light on this obscure picture

The various clinical and pathologic aspects of the so-called "hepato-renal" syndrome, as reported in the literature, deserve careful consideration, in the light of the case reported herewith Many of the reported instances of "hepato-renal" syndrome are based on clinical grounds only and lack corroborative autopsy findings Those reports that include postmortem examinations present a curious lack of uniformity of the pathologic picture Certainly, the degree and extent of the degenerative changes encountered in the liver and kidneys vary considerably Why should one patient present minimal postmortem findings while another, with the identical clinical picture, exhibits extensive degenerative changes? This considerable variation in the degree and extent of the pathologic findings suggests to us a possible explanation It seems possible that many of these patients have some degree of kidney damage before the surgical attack on the biliary system and that their margin of safety from the standpoint of kidney reserve is indeed small This impairment may not be apparent before operation or may not be demonstrable by any known laboratory methods Following the procedure on the diseased biliary tract, with its associated surgical trauma and the greatly altered physiology that must necessarily follow, the already impaired kidneys are unable to cope with the

additional load thrown upon them and soon break down completely Certainly, the clinical picture with the relatively free interval of five to ten days after operation is suggestive confirmation of this thought It must not be forgotten, too, that the same syndrome has been known to follow operations upon the gastro-intestinal tract and also, after extensive cutaneous burns, conditions known to be closely linked with disturbances of protein metabolism

There is another group of patients who develop the typical so-called "hepato-renal" syndrome and, yet, the findings at autopsy are minimal and offer no anatomic explanation of the cause of death Doctor Klemperer, pathologist at Mt Sinai Hospital, has given the case herewith reported considerable study and thought, and he feels very definitely that the slight parenchymatous degeneration of the liver and kidneys found at necropsy is insufficient to explain the cause of death Certainly, the liver sections aside from the cholangeitis show nothing of great moment, and the reason for the hemorrhages from the mucous membrane surfaces cannot be demonstrated In reviewing the sections of the kidneys, however, one is impressed by the peculiar appearance of the glomeruli Most of them are strikingly large without any cellular increase The intercapillary connective tissue framework (Zimmermann) is prominent and appears spongy, as if distended by fluid (Fig 2) The term "serous glomerulitis" is suggested to describe this feature A similar finding has been described by W G MacCallum [32] In reviewing the kidney sections of hundreds of cases showing glomerular changes in a series of about 5,000 autopsies, he noted a peculiar exudation into the glomeruli of patients dying of an acute illness, which resulted in toxic injury to the kidneys The most striking feature was the distension of the lobules of the glomeruli into a club shape by an exudate which separated the capillaries from one another and from the overlying basement membrane The latter structure was stretched and smooth and widely separated from the underlying capillaries His illustration of this condition strongly resembles that presented by the kidneys in our case In other cases, where the illness was of longer duration, the lobules were adherent and covered over by a smooth basement membrane, while the capillaries were separated by definitely stainable connective tissue He concluded that the first picture might very well be interpreted as the initial stage of glomerular injury which goes on, with continuation of the disease process, to the chronic form known to clinicians as glomerulonephritis

After a critical review of the literature and a careful study of the case reported herewith, we have formed the opinion that no logical or satisfactory explanation of the syndromes originally described by Heyd has as yet been offered Although thought by many authors to follow surgery of the biliary tract only, these clinical pictures have appeared also in cases of intestinal obstruction, cutaneous burns, *etc* The lack of uniformity of anatomic changes to explain the cause of death is noteworthy, as is also the variation in the extent of the degenerative changes We believe that the syndromes under discussion are dependent upon profound chemical changes which we are

unable to definitely determine by the clinical and laboratory methods available at the present time

REFERENCES

[1] Bartlett, W, Jr Renal Complications of Biliary Tract Infections Surg, Gynec, and Obstet, 56, 1080, 1933

[2] Behrend, M Surgical Diseases of the Gall Bladder, Liver, Pancreas, and Their Treatment Phila, F A Davis Co, 213, 1927

[3] Boyce, F F An Experimental Study of the So-called Liver Death Syndrome in Biliary Surgery Proc Soc Exper Biol and Med, 32, 479, December, 1934

[4] Boyce, F F, and McFetridge, E M So called "Liver Death"—A Clinical and Experimental Study Arch Surg, 31, 105, July, 1935

[5] Boyce, F F, and McFetridge, E M "Liver Deaths" in Surgery New Orleans Med and Surg Jour, 88, 563, March, 1936

[6] Boyce, F F, and McFetridge, E M The So-called 'Liver Death" Arch Surg, 32, 1080, June, 1936

[7] Boyce, F F, Veal, J R, and McFetridge, E M An Analysis of the Mortality of Gall Bladder Surgery Surg, Gynec and Obstet, 63, 43, July, 1936

[8] Cave, Henry W Dangers Incident to Cholecystectomy ANNALS OF SURGERY, 84, 371, September, 1926

[9] Cole, W H The Role of Hepatic Insufficiency in Surgical Problems Jour Missouri State Med Assn, 30, 351, September, 1933

[10] Colp, R, Doubilet H, and Gerber, I E The Relation of Cholecystitis to Pathologic Changes in the Liver ANNALS OF SURGERY, 102, 202, 1935

[11] Connell, F G Rapid-High Temperature Deaths Following Biliary Tract Surgery ANNALS OF SURGERY, 94, 363, September, 1931

[12] Counell, F G Liver Deaths (So called)—Rapid High Temperature Deaths ANNALS OF SURGERY, 100, 319, 1934

[13] Eiss, S Conservation of Hepatic Function in Gall Bladder Operations ANNALS OF SURGERY, 98, 348, 1933

[14] Fitz-Hugh, T, Jr Hepato-Urologic Syndromes Med Clinics N Amer, 12, 1101, January, 1929

[15] Graham, E A Hepatitis A Constant Accompaniment of Cholecystitis Surg, Gynec, and Obstet, 26, 521, 1918

[16] Helwig, F C, and Orr, T G Traumatic Necrosis of the Liver with Extensive Retention of Creatinine and High Grade Nephrosis Arch Surg, 24, 136, 1932

[17] Helwig, F C, and Schutz, C B A Liver Kidney Syndrome—Clinical, Pathological, and Experimental Studies Surg, Gynec, and Obstet, 55, 570, 1932

[18] Helwig, F C A Review of the Recent Advances in the Knowledge of the Pathology of the Liver Am Jour Surg, 19, 462, 1933

[19] Helwig, F C, and Schutz, C B A Further Contribution to the Liver Kidney Syndrome Jour Lab and Clin Med, 21, 264, 1935–1936

[20] Heuer, G J The Factors Leading to Death in Operations upon the Gall Bladder and Bile Ducts ANNALS OF SURGERY, 99, 881, June, 1934

[21] Hewitt, H W Liver Deaths Following Surgery of the Gall Bladder Jour Mich Med Soc, 34, 421, July, 1935

[22] Heyd, C G Hepatitis Associated with or Sequential to Inflammatory Diseases of the Abdomen L I Med Jour, 17, 17, 1923

[23] Heyd, C G, MacNeal, W J, and Killian, J A Hepatitis in Its Relation to Inflammatory Disease of the Abdomen A Clinical and Laboratory Study Trans Am Assn of Obstet, Gynec, & Abd Surgeons, 36, 251, 1923

[24] Heyd, C G The Liver and Its Relation to Chronic Abdominal Infection ANNALS OF SURGERY, 79, 55, 1924

[26] Heyd, C G, MacNeal, W J, and Killian, J A Hepatitis and Its Relation to Inflammatory Disease of the Abdomen A Clinical and Laboratory Study Am Jour Obstet and Gynec, 7, 413, 1924
[27] Heyd, C G "Liver Deaths" in Surgery of the Gall Bladder Tr Sect of Surg, Gen and Abd, of the A M A, p 144, 1931
[28] Heyd, C G "Liver Deaths" in Surgery of the Gall Bladder J A M A, 97, 1847, December, 1931
[29] Heyd, C G Liver Function and "Liver Deaths" Surg, Gynec, and Obstet, 57, 407, 1933
[30] Heyd, C G Significance of Liver Function from the Surgeon's Standpoint N Y State Jour Med, 33, 1317, November 15, 1933
[31] Judd, E S, Nickel, A C, and Wellbrock, W L A The Association of the Liver in Disease of the Biliary Tract Surg, Gynec, and Obstet, 54, 13, 1932
[32] Lieber, M M, and Stewart, H L Renal Changes Following Biliary Obstruction, Decompression and Operation on the Biliary Tract Arch Path, 19, 636, 1935
[33] MacCallum, W G Glomerular Changes in Nephritis Bull Johns Hopkins Hosp, 55, 416, 1934
[34] Riley, J W Post-operative Complications of Biliary Tract Surgery Their Prevention and Treatment Jour Oklahoma State Med Assn, 24, 190, 1931
[35] Schutz, C B, Helwig, F C, and Kuhn, H P A Contribution to the Study of So-called Liver Death J A M A, 99, 633, August 20, 1932
[36] Sharples, C W Liver Deaths Following Operation of Biliary Tract West Jour Surg, Obstet, and Gynec, 42, 337, 1934
[37] Stanton, E MacD Immediate Causes of Death Following Operations on Gall Bladder and Ducts Am Jour Surg, 8, 1026, May, 1930
[38] Sutton, J E, Jr High Temperature Liver Death Syndrome Proc Soc Exper Biol and Med, 32, 712, February, 1935
[39] Touroff, A S W Unrecognized Post-operative Infection A Cause of the Syndrome of So-called "Liver Shock" Surg, Gynec, and Obstet, 62, 941, June, 1936
[40] Walters, W, and Parham, D Renal and Hepatic Insufficiency in Obstructive Jaundice Surg, Gynec, and Obstet, 35, 605, 1922
[41] Weiss, S Liver Deaths and Their Prevention Am Jour Surg, New Series, 23, 96, 1934
[42] Wilensky, A O, and Colp, R Retention of Nitrogen Bodies of the Blood to Surgical Problems in Liver and in Biliary Tract Disease Arch Path, 15, 635, 1927
[43] Zimmermann, K W Uber den Bau des Glomerulus der menschlichen Niere Z mikrosk-anat Forschg, 18, 520, 1929

TUMORS VENTRAL TO THE SACRUM

LORIN D WHITTAKER, M D *
FELLOW IN SURGERY, THE MAYO FOUNDATION
AND
JOHN DEJ PEMBERTON, M D
DIVISION OF SURGERY, THE MAYO CLINIC
ROCHESTER, MINN

THE region ventral to the sacrum and sacrococcygeal joint is the site of many complex fetal changes While tumors arising in this region are rare—according to Ewing[3] occurring only once in 34,582 tumors of the newborn, and according to statistics at The Mayo Clinic, for the period 1922–1936, occurring in only one out of approximately every 40 000 registrations—their incidence is such as to prompt consideration of their pathogenesis, diagnosis and treatment

This study is based on a series of 22 cases of tumor ventral to the sacrum seen at The Mayo Clinic from 1922 to 1936, inclusive, in which the diagnosis was confirmed at operation Hundling[8] has previously reported 19 such cases which were encountered at the clinic prior to 1922, and Fletcher, Woltman and Adson[5] have previously reported in detail the five cases of chordoma which are included in this report

Located embryonically in the ventral sacrococcygeal region are the spinal cord, nerve tissue, postanal portion of the hindgut, neurenteric canal, caudal end of the notochord and the bony vertebral canal The embryonic development[2] and subsequent disappearance of the structures in this region aid in explaining the origin of these tumors The primitive streak lies posterior to the neural groove and arises, as does the neural groove, from the embryonic area The notochord is formed by the proliferation of cells from the anterior end of the primitive streak It is epithelial in origin Early in its development the notochord is surrounded by secondary mesoderm This, then, becomes the primitive vertebral column As the vertebral bodies are formed, after the fourth week, the continuity of the notochord is broken The notochord disappears in the region of the vertebral bodies, but persists in the region of the intervertebral fibrocartilages After the fourth month the notochord has disappeared as a separate structure, but remnants are believed to persist as the nucleus pulposus of the intervertebral fibrocartilages Linck and Warstat[9] were of the opinion that rests of chordal cells exist outside the axial skeleton anlage, and these can be recognized in the sacrococcygeal region in the adult These rests may lie either in the body of the sacral vertebrae or on their anterior or posterior aspects

As the notochord is forming, the primitive groove appears on the surface of the primitive streak The anterior end of the groove, which is embraced by the posterior portion of the neural fold, deepens and forms a canal between the neural groove and the ventral-lying entodermal vesicle, which is the primi-

* Now residing in Peoria, Illinois Submitted for publication May 14, 1937

tive intestinal canal This is called the "neurenteric canal" (Fig 1), and it gradually moves to a position caudal to the proctodeum The neurenteric canal is but a transitory passage and disappears in man before the neural groove closes to form the neural tube

The postanal gut is formed by the union of the proctodeum and that portion of the hindgut proximal to the neurenteric canal The proctodeum is a surface depression limited at its depth by the proctodeal membrane The disappearance of this membrane completes the formation of the rectum and anus The union of proctodeum and hindgut, however, does not take place at the distal end of the hindgut [2, 10] That portion of the hindgut distal to the union with the proctodeum is known as the "postanal gut," and it lies on the ventral

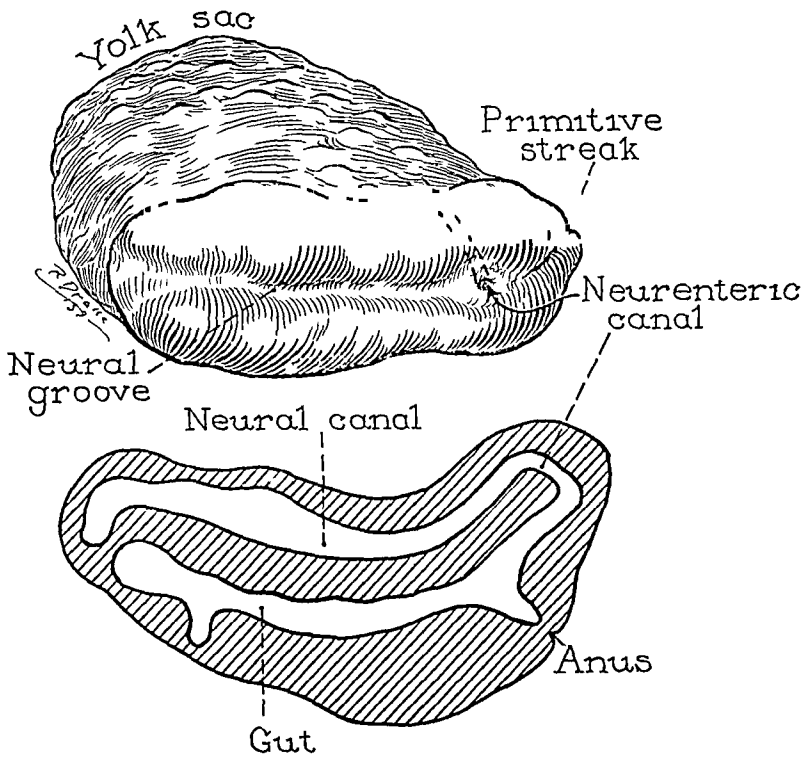


FIG 1.—Dorsal view of a human embryo 1 54 Mm long (modified after Graf Spee) Longitudinal (sagittal) section through an advanced embryo of Bombinator (modified after Goetta in Herturg Oscar, and Mark E L Textbook of the Embryology of Man and Mammals London, Swan, Sonnenschun and Co, 1892, p 120, fig 80)

surface of the coccyx (Fig 2) This structure atrophies early It is apparent, therefore, how these primitive structures, as they atrophy, may leave a nidus for further growth, with the formation of a tumor

Tumors ventral to the sacrum have at times been popularly known as "Middeldorpf" tumors, but this term should be limited to those teratomatous tumors that arise from the postanal gut, as first clearly described by Middeldorpf [10] Tumors ventral to the sacrum may vary from those the size of an egg to large growths which fill the true pelvis and push the anus and genitalia forward They may be rather superficial or be quite deeply placed within the hollow of the sacrum The tumors are usually encapsulated and rarely invade the rectum but, as will be shown later, they may invade the bony sacrum or encroach on the intervertebral foramina and compress the nerve trunks

The general symptoms produced vary greatly with the associated pathologic changes In some cases there may be no symptoms, or an indefinite dull ache or pain in the lower part of the back or pelvis, which may occasionally be associated with constipation, may be the only complaint In other cases serious nerve encroachment may produce weakness in the legs, sciatic pain, rectal or urinary incontinence, and areal numbness In some cases draining perirectal sinuses from incised dermoids are seen Consequently, digital examination of the rectum is the most valued single procedure in the diagnosis of tumors ventral to the sacrum, and this alone almost always will give the clue to the diagnosis It is important, however, to examine thoroughly the hollow of the sacrum If this is done, the true diagnosis is established and

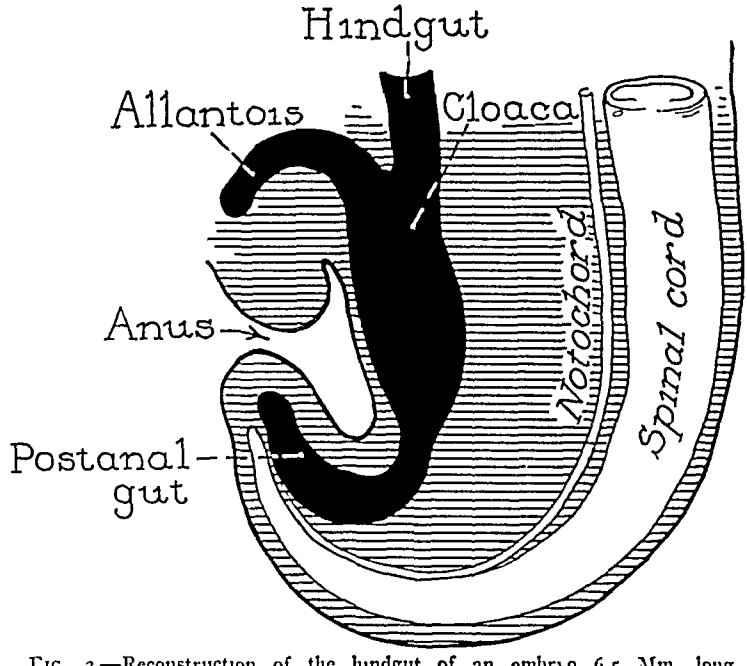


FIG 2—Reconstruction of the hindgut of an embryo 6 5 Mm long (modified after Keibel)

the patient may be saved needless hemorrhoidectomy, prostatic massage, arthritic treatment, or even laminectomy, for relief of his symptoms

Conditions to be considered in the differential diagnosis, suggested by this series of cases, include Cord tumor, tumor of the cauda equina, anterior spina bifida with meningocele, primary sarcoma of the sacrum, pelvic tumors such as ovarian cysts, fibromyomata or adenomyomata, masses of metastatic lymph nodes, rectal fistulae and perirectal abscesses

The treatment of choice is surgical removal, utilizing the posterior approach through a modified Kraske incision Radium and roentgen therapy are advised when removal is incomplete, since prolongation of life and relief of symptoms can frequently be obtained by these measures (Table I)

CHORDOMATA —The term "chordoma" was first used by Ribbert, in 1894, and the first sacrococcygeal chordoma was described by Feldmann,[4] in 1910 The term is now used to describe tumors whose cellular structure has the characteristic appearance microscopically of the notochord There are approximately 125 cases of chordoma on record [12]

TABLE I

TUMORS VENTRAL TO SACRUM

Diagnosis	No of Cases	Sex M	Sex F	Age Range	Predominant Symptoms	No of Cases Revealing Mass Rectally	Prognosis
Chordoma	8	5	3	¼ to 65	Pain in lower part of spine, nerve involvement,* constipation	8	Poor
Dermoid cyst	9		9	⅓ to 48	Dull pelvic pain, draining sinus, mass at birth	7†	Good
Teratoma	1		1	7	Perineal mass at birth	‡	Good
Fibrosarcoma	1	1		51	Pain in rectum, nerve involvement	1	Poor
Chondromyxosarcoma	1	1		73	Mass, loss of weight, constipation	1	Poor
Squamous cell epithelioma	1	1		53	Sciatic pain	1	Poor
Fibroma	1		1	29	Sacral pain	1	Good
Total	22	8	14	3 mos to 73 yrs		19	

* Sensory disturbance noted in three cases
Numbness, rectal or urinary incontinence
† No record of rectal examination in the cases of two infants
‡ No record of rectal examination

Chordomata arising from the remnant of the notochord may, as stated previously, have as their origin the nucleus pulposus or the rests of chordal cells outside the axial skeleton However, since chordomata occur with about equal frequency in the sacrococcygeal and dorsum sellae regions, and since one has not been reported in the thoracic region, it seems more plausible to many that their origin is in the choridal cell rests outside the axial skeleton anlage Anatomically the tumors seem to arise in relation to the vertebral body rather than the nucleus pulposus

Sacrococcygeal choridomata may arise within the vertebral body and project either ventrally or dorsally, or both, or they may arise ventral or dorsal to the sacrum It is only in those arising or projecting ventrally, however, that we are interested These tumors may grow to a large size, are usually encapsulated, may invade intervertebral foramina and cause pressure on nerve structures, and may cause marked bony destruction, they rarely if ever, however, involve the rectum Metastasis is rarely seen, although the incidence of recurrence is quite high, being given by Stewart[12] as 86 5 per cent Recurrent lesions are local and recurrence is usually due to incomplete removal of the original growth Grossly these tumors are gelatinous, lobulated and usually quite friable, microscopically, certain criteria have been established

on which to base the diagnosis Fletcher, Woltman, and Adson,[5] for example, have based the diagnosis on "(a) The formation of intracellular and extracellular mucus, (b) the presence of physaliphorous or vacuolated mucus containing cells, (c) the lobulated arrangement of the tumor cells, which usually grow in cords, (d) the occasional occurrence of vacuolation of the nuclei, and (e) the close resemblance to notochordal tissue as seen in the nuclei pulposi of the intervertebral disks"

The last five cases in this group of cases of chordoma have been previously reported in detail by Fletcher, Woltman and Adson They will be reviewed briefly here only to complete the series

Case 1—A girl, age five years, was brought to the clinic August 6, 1930 She had had increasing constipation for two and one-half years, and obstipation had been present for ten days Rectal examination revealed a mass posterior to the rectum, pushing it anteriorly against the pubis This mass measured 8×6×4 cm and nearly filled the pelvis Roentgenograms of the pelvis were negative The mass was removed, as completely as possible, August 15, 1930 It extended from the ventral sacrum back around the coccyx and out into the right buttock Radium was applied following operation Five months later the bowels were regular and the patient was doing nicely The microscopic report was chordoma

Case 2—A girl, age three months, was brought to the clinic March 11, 1935 In the previous three weeks her right hip had appeared larger Constipation had also been present for three weeks Examination revealed a firm mass in the right buttock Rectally the mass was felt on the right, 6 cm in diameter, pushing the rectum to the left Roentgenograms of the pelvis were negative The mass was incompletely removed March 13, 1935 It was very friable, vascular, and was invading the right gluteal muscles The patient returned home and later died The microscopic report was chordoma

Case 3—A man, age 39, registered at the clinic June 25, 1936 He had had pain in the lower part of his back and at the end of his spine for the previous five months This pain was worse at night During the same period an increasing constipation was noted Rectal examination revealed a firm, smooth rounded mass, 7×5 cm, posterior to the rectum and attached to the sacrum It was not tender The lumen of the rectum was partially obstructed Roentgenograms revealed destruction of the lower half of the sacrum The tumor was removed as completely as possible July 7, 1936 It was encapsulated Roentgen therapy was instituted following operation On discharge the patient was free of symptoms and only some roughness of the sacrococcygeal area persisted The microscopic report was chordoma (Fig 3)

Case 4—A woman, age 65, registered at the clinic September 4, 1923 She had had a severe, sharp pain at the end of her spine for five years Hemorrhoidectomy and injection of the peri-anal nerves with alcohol, in 1920, had given no relief There was sciatic projection of this pain, and rectal incontinence and some loss of vesical control was also noted Rectal examination revealed a relaxed anal sphincter and a mass ventral to the sacrum Sensory impairment of the fourth and fifth sacral nerves was found Roentgenograms revealed destruction of the upper portion of the sacrum On October 6, 1923, the tumor, which had invaded the sacrum, was incompletely removed and radium was applied The patient died two years later The microscopic report was chordoma

Case 5—A man, age 58, registered at the clinic January 26, 1925 He had had progressive tenderness and pain at the end of his spine for three months Rectal examination revealed a hard round mass, 4 cm in diameter, posterior to the rectum It was not tender Roentgenograms revealed necrosis of bone in the sacrum The tumor was removed as thoroughly as possible January 30 Radiotherapy was then instituted Nine years later the patient felt well The microscopic report was chordoma

Case 6—A man, age 47, registered at the clinic for the second time April 6, 1925, with the complaint of pain and numbness in the region of his rectum and coccyx of 18

months' duration He had also had progressive trouble with his bladder for one month Rectal examination revealed a relaxed anal sphincter associated with anesthesia A firm, smooth, fixed mass, 7 cm in diameter, was palpated ventral to the sacrum, and roentgenograms revealed destruction of the lower two-thirds of the sacrum On May 9, 1925, incomplete removal of the mass was accomplished It was friable and resembled a colloid tumor Roentgen therapy was administered In 1929 a recurrent growth was partially removed The patient died five years after the onset of his symptoms The microscopic report was chordoma

Case 7—A man, age 61, registered at the clinic December 9, 1927 He had had progressive pain in his right hip associated with sensory disturbance for eight months Urinary incontinence had been present for three weeks Rectal examination revealed a relaxed sphincter and a firm mass filling the pelvis, apparently arising from the ventral aspect of the sacrum Roentgenograms revealed some destruction of the sacrum



FIG 3—(Case 3) Photomicrograph of chordoma

Biopsy only was attempted and radiotherapy was advised The microscopic report was chordoma

Case 8—A man, age 26, first registered at the clinic August 19, 1930 He had had pain at the end of his spine, which was projected to the genitalia and inner thigh, and increasing constipation for one year Rectal examination revealed a fixed tumor, 7 5 cm in diameter, ventral to the sacrum He was operated upon, elsewhere, and was given radium treatment He returned to the clinic January 7, 1932, complaining of severe pain Examination at this time revealed urinary and rectal incontinence and a mass ventral to the sacrum Roentgenograms revealed cystic degeneration of the right half of the sacrum The mass was removed as completely as possible January 14, 1932 On discharge the patient was free of pain and the function of his bladder had improved The microscopic report was chordoma

Five of these eight patients were males and three females In only two cases was there any suggestive history of previous trauma The ages ranged throughout the life span, two of the patients being children Sacrococcygeal chordomata are quite rare in children

Pain was the initial symptom in the case of each adult patient This pain was usually localized in the back at the lower end of the spine Sciatic projection was frequent Later, sensory disturbances frequently appeared,

as did urinary and rectal incontinence Involvement of nerves depended on encroachment of the tumor on the sacral nerve plexus and trunks Constipation was frequently noted Roentgenograms revealed some bony destruction of the sacrum in five of the cases The duration of symptoms varied from three weeks to five years, the average being 17 months Rectal examination revealed a mass in each case, and was the most valuable single finding in the examination The mass was firm, usually smooth, fixed to the sacrum, and was not tender

The diagnosis can be made positively only after microscopic examination However, the presence of a firm, smooth, fixed and nontender mass ventral to the sacrum, associated with pain in the sacral region, later with sensory disturbances and usually with rectal and urinary incontinence, is quite suggestive of sacrococcygeal chordoma The conditions which most frequently have to be considered in the differential diagnosis of sacrococcygeal chordoma are Tumor of the cauda equina, meningocele and sarcoma or enchondroma of the sacrum

Surgical removal of the tumor as completely as possible offers the best chance for cure The Kraske type of incision posterior to the rectum, with removal of the coccyx, probably gives the most satisfactory approach to these tumors, however, the dorsal approach, unroofing the tumor and removing it intrasacrally, may be a better approach when marked involvement of the sacrum is present Because of its ramifications, complete removal of the tumor is sometimes very difficult

The prognosis in this group of cases is quite poor and the percentage of local recurrence is extremely high However, surgical removal followed by extensive irradiation does prolong life, relieve pain and often gives a long period of freedom from symptoms Chesky[1] reported the average length of life after operation to be six and one-half years

Dermoid Cysts.—Dermoid cysts are ectodermal in origin and are lined with epithelium which is constantly secreting and desquamating Such cysts are filled with sebaceous material and may contain ectodermal derivatives These cysts occur where ectodermal structure is not found under normal conditions It is generally agreed that such cysts originate by inclusion of a portion of ectoderm during faulty coalescence of cutaneous surfaces in embryonic life They occur along the course of ectodermal invaginations Those presenting as tumors ventral to the sacrum may arise from the proctodeal membrane or from coccygeal vestiges Galletly[6] was of the opinion that they may also arise from the neurenteric canal, which is an ectodermal invagination

Dermoid cysts may be located close to the sacrococcygeal region or be quite deeply situated in the hollow of the sacrum If large, they may bulge into the perineum and push the genitalia forward or they may encroach on the rectal lumen These cysts are encapsulated, have little or no blood supply of consequence, never invade the rectum, but if large may infrequently cause erosion of the sacrum and injury to nerve trunks They are not fixed primarily

ABBREVIATED REPORT OF NINE CASES OF DERMOID CYSTS

Case 1—A woman, age 30, registered at the clinic November 15, 1922 She had undergone an operation for a perirectal "abscess" elsewhere, and a draining perirectal sinus had persisted She had also been subjected to three operations for fistula-in-ano Rectal examination at the clinic revealed a definite thickening on the posterior rectal wall 7 5 cm above the anal margin On August 31, 1923, the sinus tract was dissected out, and it was found to lead to a small cyst anterior to the sacrococcygeal joint The pathologic diagnosis was dermoid cyst containing hair

Case 2—A woman, age 23, registered at the clinic June 2, 1925 She had had urinary difficulty for six months and partial rectal incontinence for five months Rectal examination revealed a firm mass ventral to the sacrum which pushed the rectum to the right and displaced the pelvic organs upward Roentgenograms of the pelvis were negative On June 8, 1925, a large mass, 10 cm in diameter, which was buried in the hollow of the sacrum, was completely removed Complete relief of symptoms followed The pathologic diagnosis was dermoid cyst containing only fat

Case 3—A girl, age four months, was brought to the clinic August 9, 1926 A tumor over her right buttock had been noticed at birth It had recently become more prominent Examination revealed a soft tumor with firm nodules extending up to the sacrum, and roentgenograms revealed a soft tissue shadow below the pelvis on the right On August 14, 1926, a mass 10 cm in diameter, arising ventral to the sacrum and extending down to the right buttock, was completely removed Complete relief of symptoms followed The pathologic diagnosis was polcystic dermoid containing fat and hair

Case 4—A girl, age seven months, was brought to the clinic June 23, 1928 Since birth she had had a large mass in the sacrococcygeal region posteriorly Roentgenograms revealed lower lumbar and sacral spina bifida On June 28, 1928, the mass, which measured 25×15×10 cm, was removed from the sacrococcygeal region A second mass, about 7×5 cm, and ventral to the sacrum, was later found and this also was removed Recovery was complete The pathologic diagnosis was dermoid cyst

Case 5—A woman, age 48, registered at the clinic September 23, 1929 She complained of distress in the lower part of her pelvis and rectum of six months' duration Rectal examination revealed a fluctuating mass ventral to the sacrum, 2 cm above the anal margin Roentgenograms of the sacrum were negative On September 27 the fluctuating mass was incised and about 100 cc of thick pus escaped The thick-walled sac was removed and recovery was complete The pathologic diagnosis was dermoid cyst

Case 6—A woman, age 40, registered at the clinic December 5, 1932 She had had a dull pain in the lower part of her abdomen and sacral part of her back for 15 years A perirectal draining sinus had been present since incision of an abscess years before Rectal examination revealed a hard, irregularly lobulated mass arising from the left lateral wall of the sacrum On December 8, 1932, the mass was incised and 120 cc of putty-like matter escaped Marked inflammation was present The mass was excised as completely as possible Slight drainage persisted intermittently for some time The pathologic diagnosis was dermoid cyst

Case 7—A woman, age 44, registered at the clinic August 9, 1934 For three months she had noticed some discomfort in the rectum after a bowel movement She had accidentally discovered a "tumor" in her rectum three months prior to registration while giving herself an enema Rectal examination revealed a smooth soft mass ventral to the sacrum, and roentgenograms revealed spina bifida of the fifth lumbar and first sacral vertebrae On August 21, 1934, a mass measuring about 7×5 cm was enucleated from the ventral portion of the sacrum Recovery was complete The pathologic diagnosis was dermoid cyst

Case 8—A girl, age two and one-half years, registered at the clinic June 24, 1935 She had had a gradually enlarging tumor over the lower end of the sacrum since birth Rectal examination revealed a mass measuring 4×8 cm, ventral to the sacrum and palpable just within the rectal sphincter Roentgenograms revealed an anomaly of the last sacral vertebra On June 28, 1935, a cystic mass filled with thick creamy material

was found extending from the coccyx to the ventral surface of the sacrum, it was completely removed It measured 5×4×3 cm Drainage persisted for some time The pathologic diagnosis was dermoid cyst

Case 9.—A woman, age 33, registered at the clinic July 6, 1936 She had had a dull constant ache in the lower part of her back for more than 15 years Rectal examination revealed a mass 10×6×4 cm, lying ventral to the sacrum and to the left of midline It was fixed and was not tender Roentgenograms revealed a soft tissue shadow in the lower part of the pelvis On July 10, 1936, the mass, which was found to be well encapsulated, was removed in its entirety Recovery was complete The pathologic diagnosis was dermoid cyst

It is interesting that each of these nine patients was a female Three of them were infants, and the average age of the other six was 36 The infants presented sacrococcygeal tumors at birth, two patients had had symptoms for 15 or more years, and four patients had had symptoms for from three to seven months In two cases incision of an "abscess" had been performed, this was followed by a persistent discharge until the time of excision of the dermoid cyst Roentgenograms were made in seven cases and in two cases associated lumbar and sacral spina bifida was noted In one case there was an anomalous last sacral vertebra

The symptoms are not pointedly suggestive Four patients complained of dull aching distress in the lower part of the back or abdomen, or in the rectum One patient complained of a perirectal draining sinus, and one complained of partial urinary and rectal incontinence The three infants presented definite evidence of a tumor Rectal examination revealed the mass ventral to the sacrum in seven cases, rectal examination was not made in the cases of two infants In those cases uncomplicated by a draining sinus or a previous operative attempt at drainage or removal rectal examination revealed smooth fluctuant masses which were movable or only partially fixed and were not tender on pressure In cases complicated by previous operation to institute drainage, marked inflammatory reaction may occur about the tumor and it may then become fixed and tender

The posterior surgical approach is the one of choice Complete removal of the lining of the dermoid cyst is essential and usually, complete enucleation can be carried out without difficulty If this is done the wound heals rapidly and complete relief of symptoms will follow

Teratomata.—Teratomata are tumors in which tissue representing all three embryonal layers are arranged in disorderly fashion Their origin is not well defined, various theories having been presented which are based on either their bigerminal or monogerminal origin The bigerminal theory explains the origin of such tumors as an independent development of a blastomere during segmentation, a rudimentary duplication, or the so called parasitic twin The monogerminal theory explains their origin as disorderly growths of remnants of fetal structures

In the ventral sacrococcygeal region there are possibly sufficient fetal remnants to explain the various types of teratomata without resorting to the bigerminal theory of rudimentary twin Middeldorpf was the first to attribute teratoma ventral to the sacrum to the persistence of a fetal structure He pre-

sented the case of a girl, one year old, who had had a tumor in the region of the anus since birth It opened to the outside and occasionally discharged a dark brown mucoid fluid There was no connection with the rectum This tumor was composed of fatty tissue containing a structure resembling a small loop of intestine He believed that the tumor was derived from the postanal gut Hansmann[7] was of the opinion that when the neurenteric canal remnant was the source of a tumor, there was frequently an associated anterior sacral defect

Teratomata are most frequently found in the newborn and in infants The attachment to the rectum is not intimate, but it may be to the sacrum or coccyx, they may be attached to the sacrum by a pedicle or may be enveloped in a capsule

Case 1—A girl, age seven, was brought to the clinic June 20, 1929 A large mass protruding from the perineal region had been noted since birth Rectal examination was not made Roentgenograms revealed a large soft tissue mass in the pelvis containing fragments of bone The sacral curve was absent At operation, June 25, 1929, the mass was found to be attached to the ventral median raphe of the sacrum and coccyx, displacing the genitalia downward and anterior This mass was completely removed It weighed 550 Gm The perineal portion measured 10×7 cm and the portion ventral to the sacrum was 9 cm in diameter Recovery was complete The pathologic diagnosis was teratoma

MISCELLANEOUS TUMORS—This group of tumors ventral to the sacrum consisted of three malignant tumors (a fibrosarcoma, chondromyosarcoma, and a squamous cell epithelioma, possibly vesical in type) and one benign tumor (fibroma) There was no evidence of malignancy elsewhere in any of the cases of malignant tumor Two of these patients with malignant lesions had symptoms of nerve root pressure, the third complained only of pain and constipation In the case of the fibroma there was marked inflammatory fixation, which permitted only partial removal

Case 1—A man, age 51, registered at the clinic July 9, 1928 He had had a dull aching pain in the rectum, bearing down in type, of increasing severity for one year Weakness in his legs had been present for six months, sciatica for two months, and urinary difficulty for two months Rectal examination revealed a relaxed sphincter and an irregular, nontender mass ventral to the sacrum Roentgenograms of the pelvis were negative On July 18, 1928, a large tumor, 10×15×5 cm, was found eroding the ventral surface of the sacrum The mass was removed almost in its entirety, it weighed 122 Gm The patient died one year later The pathologic diagnosis was fibrosarcoma

Case 2—A man, age 73, registered at the clinic November 29, 1934 He had had a mass in the coccygeal region with pain on sitting for eight months Constipation had been present for six months He had lost 35 pounds (15.9 Kg.) in the two years prior to his registration Rectal examination revealed a firm mass ventral to the sacrococcygeal area, and roentgenograms revealed destruction of the lower part of the sacrum and coccyx A soft tissue shadow was present On December 12, 1934, the tumor, which had encroached on the rectum, was incompletely removed It weighed 350 Gm Again on January 14, 1936, a recurrent tumor about 6×4 cm was removed Radium treatment was instituted and there was some improvement The pathologic diagnosis was chondromyxosarcoma

Case 3—A man, age 53, registered at the clinic December 26, 1931 He had had severe sciatic like pain, shooting in character, for four months Some numbness and tingling of the left leg had also been present for four months Rectal examination revealed a hard, fixed mass behind the rectum ventral to the sacrum It was not tender Roentgenograms of the pelvis were negative At operation January 5, 1932, the mass,

which was found to be high in the hollow of the sacrum, was incompletely removed Extensive radiotherapy followed The patient died six months later At the time of his examination and at operation no other evidence of malignancy was found The pathologic diagnosis was squamous cell epithelioma, possibly vesical in type

Case 4 —A woman, age 29, registered at the clinic February 15, 1929 She had had a dull aching pain, without projection, in the sacral region for six months Rectal examination revealed a mass posterior to the rectum The mass was rounded, smooth, not tender, and extended almost to the promontory of the sacrum At operation, March 1, 1929, the mass was found to be quite fixed and edematous It was incompletely removed The pathologic diagnosis was fibroma

SUMMARY

Tumors arising ventral to the sacrum probably arise from remnants of fetal structures The most important fetal changes in this region include the development and subsequent disappearance of the notochord, neurenteric canal, proctodeum and hindgut

The subjective symptoms of tumor ventral to the sacrum are not definitely suggestive but include pain in the sacral region, constipation, and vesical and rectal incontinence Rectal examination revealed the mass in each case in which it was made It is the most important single diagnostic procedure

The most satisfactory treatment of such tumors is surgical excision through a modified Kraske type of posterior incision In the case of malignant tumors complete removal is often difficult and radiotherapy may help to relieve pain and to prolong life

The incidence of recurrence is high, and recurrence is usually local The prognosis varies with the type of tumor, being poor in instances of malignancy

REFERENCES

[1] Chesky, V E Sacrococcygeal Chordoma Arch Surg, 24, 1061–1067, June, 1932
[2] Cunningham, D J Textbook of Anatomy Ed 5 New York, William Wood and Company, 27–55, 1923
[3] Ewing, James Neoplastic Diseases A Treatise on Tumors Ed 3 Philadelphia, W B Saunders Company, 1035, 1928
[4] Feldmann, I Chordoma Ossis Sacri Beitr z path Anat u z allg Path, 48, 630–634, 1910
[5] Fletcher, Eleanor M, Woltman, H W, and Adson, A W Sacrococcygeal Chordomas a Clinical and Pathologic Study Arch Neurol and Psychiat, 33, 283–299, February, 1935
[6] Galletly Quoted by Raven, R W Sacro-coccygeal Cysts and Tumors Brit Jour Surg, 23, 337–361, October, 1935
[7] Hansmann, G H A Congenital Cystic Tumor of the Neurenteric Canal with Special Reference to Its Histology and Pathological Significance Surg, Gynec & Obstet, 42, 124–127, January, 1926
[8] Hundling, H W Ventral Tumors of the Sacrum Surg, Gynec & Obstet, 38, 518–533, April, 1924
[9] Linck, A, and Warstat Quoted by Kwartin, Boris, and Stewart, J D Sacrococcygeal Chordoma ANNALS OF SURGERY, 86, 771–775, November, 1927
[10] Middeldorpf, K Zur Kenntniss der angebornen Sacralgeschwulste Virchow's Arch f path Anat u Physiol, 101, 37–44, July, 1885
[11] Ribbert Uber die Ecchondrosis Physalifora Sphenooccipitalis Centralbl f allg Path u path Anat, 5, 457–468, 1894
[12] Stewart Quoted by Harmos, Oscar, and Palmer, L A Chordomata and Report of Case Virginia Med Month, 62, 638–648, February, 1936

INTRAMEDULLARY DERMOID CYST

F KEITH BRADFORD, M D

CHICAGO, ILL

DERMOID and epidermoid tumors within the spinal canal are of infrequent occurrence About one-third of those reported are intramedullary tumors But of the intramedullary group, epidermoid tumors are much more common than true dermoid cysts

Gross[5] collected from the literature 19 dermoid and epidermoid tumors within the spinal canal to which he added one In order to bring the literature up to date the following additional cases of dermoid and epidermoid tumors have been collected and classified as carefully as the original papers permit

Shallow's[15] patient was a man, age 30, who had had pain in the lumbar region, urinary retention, and hyperesthesia of the sacral dermatomes for three years At operation an extramedullary tumor filling the spinal canal at the level of the fourth lumbar vertebra and compressing the cauda equina was removed with subsequent improvement The cyst was lined by cornified, stratified squamous epithelium and contained many sebaceous glands and a few hair follicles Through the courtesy of Dr B L Crawford of the Jefferson Hospital in Philadelphia I was able to examine sections of this tumor It is classified as an extramedullary dermoid cyst

Delrez[4] reported the case of a female, age 5, who for four months had had urinary and fecal retention, a paraplegia, and anesthesia of the sacral dermatomes At operation an extradural tumor involving the cauda equina extended from the third lumbar to the first sacral vertebra The tumor which contained grayish-yellow cheesy material was removed with resulting improvement One year later the patient died of a metastasizing abdominal tumor which the author considered a sarcoma of the kidney No necropsy was performed No description of the microscopic appearance of the surgical specimen is given The pathologist's diagnosis of dermoid cyst must, therefore, be accepted provisionally

The case reported by Craig and Mitchell[3] was that of a boy, age 8, who gave a history of pain in his back, tired feeling in the lower extremities, and occasional enuresis for three years The only neurologic findings were absent knee jerks and hyperesthesia of both groins The tumor disclosed at operation was extramedullary, 3 6 cm in length, compressing the conus medullaris and cauda equina at the level of the last thoracic and first lumbar vertebrae The patient was relieved of all symptoms The tumor contained the typical crumbly, pearly contents of an epidermoid growth Microscopic examination revealed a lamellated appearance, but no nuclei The tumor is classified as an extramedullary epidermoid of cholesteatomatous type

Submitted for publication April 24, 1937

Schroeder's[14] patient was a woman, age 35, who had had a paraplegia and hypesthesia below the second lumbar dermatome for 18 months At operation an extramedullary tumor 2 5 cm long was removed at the level of the last two thoracic vertebrae where it compressed the conus medullaris The patient recovered The tumor was cystic, filled with yellowish white material Microscopically the cyst was lined with cornified, stratified squamous epithelium The tumor is an extramedullary epidermoid

Bouchut, Dechaume, and Michailidis[1] have reported the case of a man, age 71, who had had pain in his lower extremities of 15 years' duration which lessened as motor difficulty increased Urinary retention had been present for ten years Examination showed a paraplegia and hypesthesia of the last lumbar and all the sacral dermatomes At necropsy an intramedullary tumor of the conus medullaris was found to have enlarged the cord so that it filled the canal at the level of the twelfth thoracic vertebra On section the cyst which filled the cord was seen to contain an oily, pearly lamellated substance which was assumed to be sloughed layers of epidermis In addition, there was a dysembryoplasia of the adjacent portions of the spinal cord with muscle, glial tissue, and syringomyelic cavities lined by epithelium with the appearance of ependyma This is concluded to be a case of intramedullary epidermoid of cholesteatomatous type associated with a malformation of the spinal cord

Ottonello's[12] patient was a woman, age 20, who had had pain in the scapular region one year before with the gradual appearance subsequently of paresis and sensory loss in her lower extremities Physical examination revealed a dimple at the level of the third thoracic vertebra through which a sinus emptied At operation an extramedullary tumor 6 5 cm long and 2 cm wide, which had compressed the cord at the second, third, and fourth thoracic vertebrae, was removed and along with it a sinus which connected the tumor to the dimple just mentioned The cyst contained sebaceous material and many hairs The lining of the cyst was a poorly developed stratified squamous epithelium Although it was obstructed in places, the sinus communicated with the cyst More superficially the sinus contained in its wall abundant hair follicles and sebaceous and sudoriferous glands But these gradually diminished in number in the deeper portions and had disappeared entirely where the sinus communicated through the dura mater with the cyst This case is classified as an extramedullary dermoid cyst and congenital dermal sinus

Hipsley[6] reported, as a dermoid cyst within the spinal canal, a case which appears to be one of congenital dermal sinus A female, age 3, had at the level of the first thoracic spine a sinus which had been draining For four weeks there had been difficulty in walking and severe pain in the left chest Examination revealed a red area 2 5 cm in diameter around the sinus opening from which a few hairs could be seen protruding A probe passed easily into the sinus to a depth of 2 5 cm Attempts to flex the thoracic spine were resisted At operation the spine of the second thoracic vertebra was found to be bifid and through a perforation in its base, sebaceous material escaped

An extramedullary mass, 1 8 cm long and 1 2 cm wide, was firmly adherent to the dura mater It was removed with subsequent improvement of the patient The meager description given states "The contents and lining of the cyst resembled the contents and lining membrane of a sebaceous cyst of the skin" It seems probable that this is simply a case of congenital dermal sinus, chronically infected, symptoms occurring when drainage ceased from obstruction of the sinus The hairs protruding from the ostium rule out any other kind of sinus It would, however, be possible that the cystic mass removed at operation was a dermoid cyst combined with a congenital dermal sinus as in the case reported by Ottonello

Of the four cases recently reported by Naffziger and Jones[11] the third case is omitted here because it is very doubtful that it comes within the group described in this paper The first and fourth cases were dermoid cysts, the second, an epidermoid The first case was subarachnoid, the second and fourth, subpial Roentgenologic changes, consisting of erosion of the pedicles and bodies of the vertebrae, occurred only in the first two cases There was in addition a sacral spina bifida in the first case of the series

The first case occurred in a woman, age 62, who had complained of pain in her back for 42 years and a paraplegia for one year A tumor 1 5 2 cm long and 3 8 cm wide involving the cauda equina from the twelfth thoracic to the second sacral vertebrae was partially removed with almost complete recovery subsequently Most of the mass removed was a crumbly, fatty material containing many hairs, but there was also a portion of capsule which revealed, upon microscopic examination, a thinned-out layer of stratified squamous epithelium

The second case was in a woman, age 27, who developed incontinence of urine and feces following pain in her back for two years A cystic tumor weighing 9 Gm involving the conus medullaris from the last thoracic to the second lumbar vertebrae was removed with good improvement The cyst was lined with a stratified squamous epithelium

The fourth case occurred in a man, age 45, who had suffered with urinary symptoms for 16 years During the last two years pain in the sacral dermatomes and a paraparesis had developed At operation a subpial tumor 5 5 cm long was found extending from the eleventh thoracic to the third lumbar vertebrae Below, it compressed the cauda equina and it was possible to separate the capsule, but above, the capsule merged with the conus medullaris from which it had to be severed Microscopically there was found to be a hyperkeratotic, stratified squamous epithelium beneath which were scattered hair follicles, sebaceous and sweat glands, and fat cells

Puech, Plichet, Visalli, and Brun[13] have reported the case of a man, age 37, who had had paresthesias, paraparesis, and urinary disturbance for one year At operation an intramedullary tumor weighing 4 Gm was removed piecemeal at the level of the sixth and seventh thoracic vertebrae with subsequent recovery Microscopic examination revealed only a rather struc-

tureless, lamellated mass without cells This tumor can be classified as an intramedullary epidermoid of cholesteatomatous type

A case pathologically very similar to the one here presented has been reported by Love and Kernohan [8] A man, age 40, had complained of a progressive paraparesis and incontinence Following the demonstration with lipiodol of a subarachnoid block opposite the second lumbar vertebrae, a laminectomy was performed which revealed a cystic mass within the conus medullaris On incision of this, grumous material, hair and material resembling pus escaped The wound healed without infection, but the patient's neurologic condition was little altered Diagnosis Intramedullary dermoid cyst

SYNOPSIS OF CASE REPORT

The patient, a male, age 3, developed normally until one year before admission when pain occurred at irregular intervals in both lower extremities, two months prior to admission pains became more severe, and were accompanied by fecal and urinary incontinence and inability to walk Examination showed a rather flaccid paraparesis, peri-anal analgesia, and a palpable defect in the sacral laminae Roentgenologic examination revealed marked dilatation of the lumbar canal Operation was performed consisting of incision and excavation of an intramedullary dermoid cyst and excision of a mural nodule Subsequent improvement occurred

Case Report—No 157304 D W, male, age 3, was first seen by the Pediatric Service of the University of Chicago Clinics August 7, 1936 Chief complaint "Pain in lower extremities and inability to walk for six weeks"

The patient was the only child of a mother, age 20 The birth weight was six pounds, six ounces The pregnancy and delivery were normal Both parents were in good health and there was no history of familial disease The child sat up at six months, talked at 12 months, and walked at 13 months Dentition was normal, and the patient had been continuously well except for his present illness

In August, 1935 (age two), the patient first complained of pains in both lower extremities These were described as being intermittent and worse first in one place then in another These pains progressed for almost a year before other symptoms developed

In June, 1936 (age three), the pain was so severe that the patient asked to be carried when going somewhere instead of walking as formerly It was soon evident that the lower extremities were too weak for the patient to walk although he could be held in a standing position and take a few steps The patient also became incontinent of feces and urine although he had previously had perfect control Since June, 1936, the patient had been extremely irritable and uncomfortable, frequently refused to eat, and had lost seven pounds in weight

Examination August 7, 1936, revealed a well developed, thin, blond male, apprehensive and irritable Temperature normal, complete blood count and uranalysis were negative, weight 26 pounds The patient lay supine with his legs moderately flexed and objected to other positions He was quite intelligent and bright as was evident when his apprehension was overcome The chest and abdomen were negative The left testis was undescended, but the genitalia were otherwise normal The teeth were in good condition and the nose and throat normal

Neurologic Examination revealed a normal head, but the neck was slightly stiff and the patient complained when it was flexed The cranial nerves were normal throughout Motor function, sensation, and reflexes were normal in the upper extremeties and trunk The abdominal reflexes were active and equal Motor function was very difficult to determine in the lower extremities The patient complained when his

legs were manipulated in any manner, especially upon the Kernig test All movements seemed possible, but the patient was reluctant to use his extremities because of pain Atrophy was present in the left buttock, but to no great extent elsewhere The limbs were flaccid although not extremely so Sensation to pin prick, judged by the patient's responses, was normal except in the peri-anal region where little response to painful stimuli was obtained The plantar reflexes were normal The tendon reflexes were variable and hypo-active although both knee jerks and both ankle jerks were obtainable When supported, the patient could stand, keeping his knees and hips flexed A few faltering steps were possible when the patient was well supported, but it was impossible

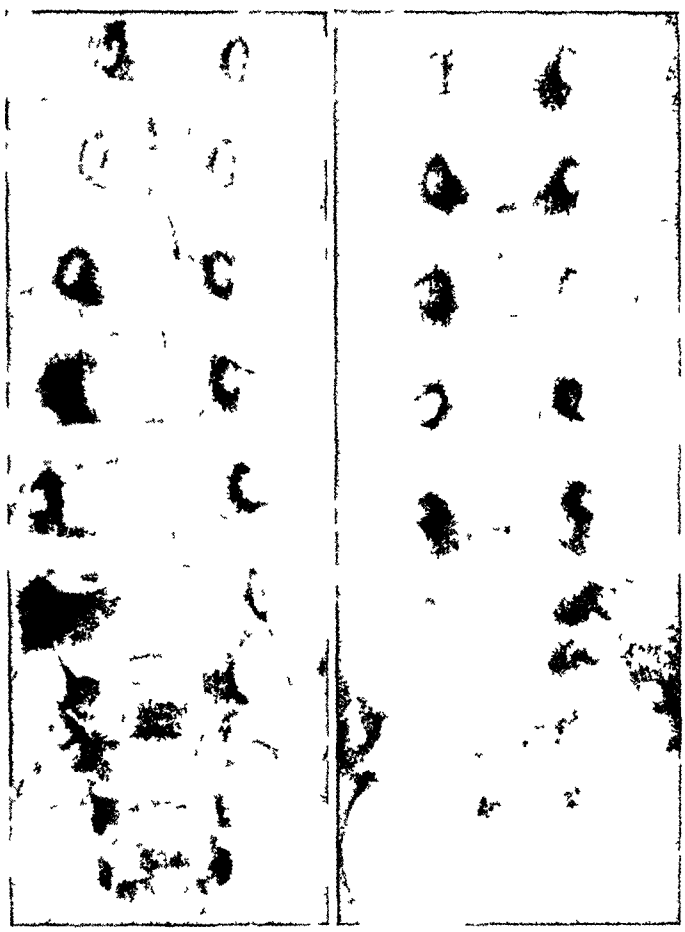


FIG 1.—On the left is a reproduction of the roentgenogram of the lumbosacral spine of the patient with an intramedullary dermoid cyst On the right a roentgenogram of a normal lumbosacral spine in a child of the same age has been reproduced for comparison The dilatation of the spinal canal without any appreciable thinning or deformity of the pedicles is clearly shown

for him to stand or walk alone Over the lumbosacral joint was a tuft of blond hair several centimeters long, and at the tip of the coccyx a dimple was present, but the skin was intact and not inflamed nor did any sinus lead from it Palpation over the sacrum revealed an absence of the sacral laminae

Roentgenologic Examination August 7, 1936, revealed a remarkable dilatation of the spinal canal in the region of the fourth and fifth lumbar and the first sacral vertebrae (Fig 1) There was a failure of fusion of the laminae of the fourth lumbar vertebra and for this age, normal lack of fusion of the lumbar and the sacral vertebrae

A preoperative diagnosis of spina bifida occulta with intraspinal tumor or myelodysplasia was made

Operation—August 11, 1936 Dr Paul C Bucy performed a laminectomy of the last four lumbar and the first sacral vertebrae The spines and laminae were normal except that the fourth lumbar vertebra contained a small defect in the laminae besides an incompletely developed spinous process The fifth lumbar contained a somewhat larger defect, and the first sacral vertebra had the developing bone of the spinous process and laminae still separate from the remainder of the vertebra At the level of the fourth and fifth lumbar vertebrae the canal was grossly enlarged and the dura mater was quite tense Upon incising the dura mater it was apparent that a tremendously dilated spinal cord entirely filled the caudal end of the dural sac The greatest dilatation of the spinal cord was at the level of the fourth and fifth lumbar vertebrae where it was

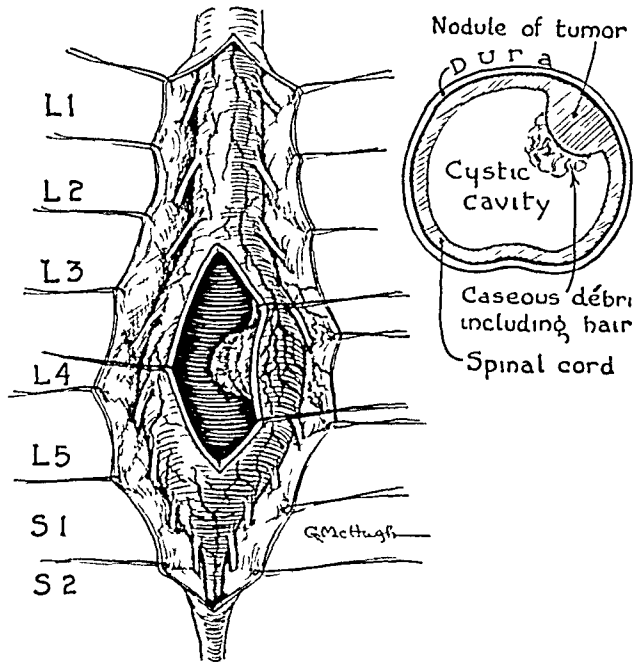


FIG 2—The drawing at the left represents the appearance at operation The cord has been incised between the posterior columns exposing a large cystic cavity which extends both above and below the incision A nodule is seen on the right its inner surface covered with caseous debris and hair There are numerous small blood vessels over the surface of the thinned portion of spinal cord to which the nodule is attached At the right is a diagrammatic cross section through the conus medullaris at the level of the nodule

increased to four or five times the normal size Above this level, extending to the third lumbar vertebra, the dilatation was to about twice the normal size At the top of the exposure the dura mater pulsated normally On the right side at the fourth lumbar vertebra there was on the surface of the dura mater a tangle of arteries and veins considerably more extensive than elsewhere With the dura mater open it could be seen that five or six of these vessels passed to the spinal cord with a corresponding increase in vascularity at this point The posterior roots taking their origin in the tensely dilated spinal cord could be seen coursing caudally and laterally over it Because of its cystic appearance the spinal cord was aspirated and 12 cc of whitish yellow, opaque fluid were obtained On microscopic examination this showed many epithelial cells The cord was then incised longitudinally between the posterior columns exposing a cyst lined by a translucent membrane (Fig 2) More fluid was obtained and several masses of caseous material in which were mingled many fine blond hairs With the collapse of the spinal cord it was evident that the vessels entering its right side at the level of the

fourth lumbar vertebra passed into a nodule in the cord which constituted a part of the cyst wall Considerable caseous material containing hair was losely adherent to the nodule The nodule was extirpated, bleeding was controlled by means of silver clips In addition a portion of the lining of the cyst at a considerable distance from the tumor nodule was removed for examination All the fluid and caseous material was carefully evacuated and the incision in the spinal cord left open At the lower end of the dural sac, at the junction of the first and second sacral vertebrae, the spinal cord terminated in a small, round structure comparable to the filum terminale which passed out of the dural sac and merged into the surrounding fatty tissue The dura mater was closed with fine silk sutures and the muscles and skin approximated with layers of interrupted silk sutures

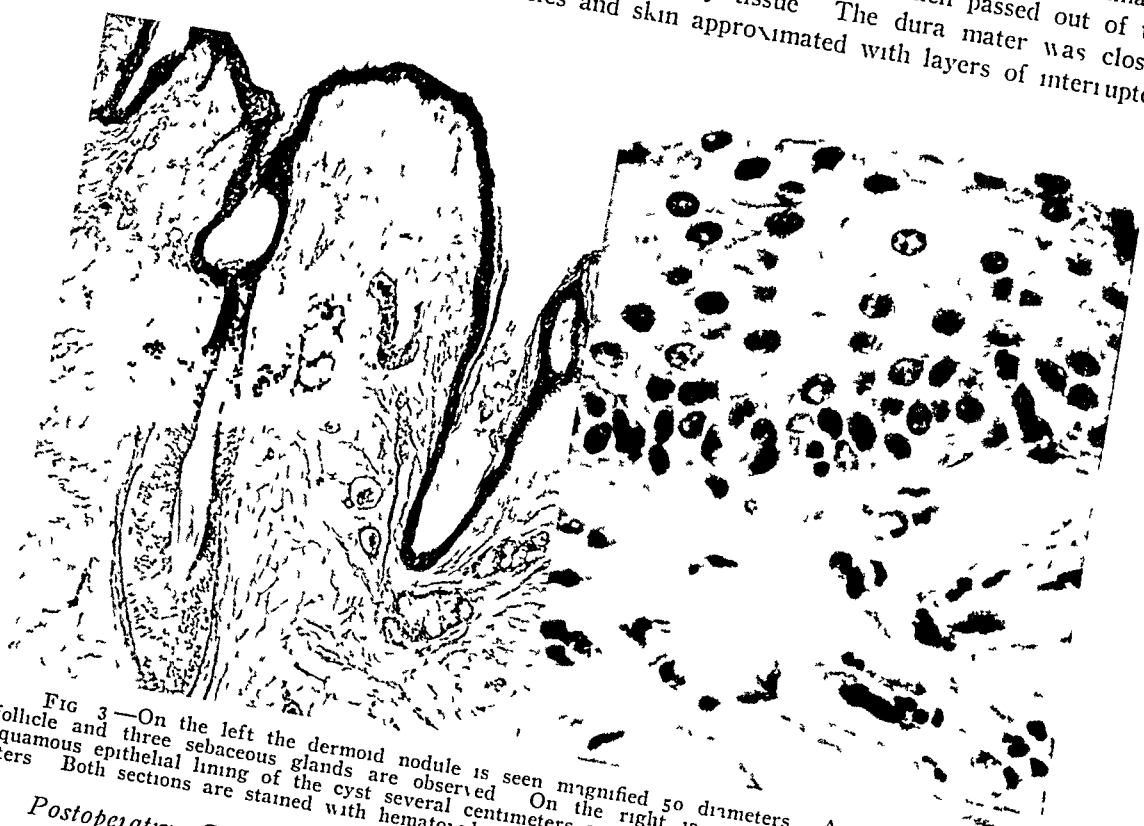


FIG 3 —On the left the dermoid nodule is seen magnified 50 diameters A well developed hair follicle and three sebaceous glands are observed On the right is seen the noncornified, stratified squamous epithelial lining of the cyst several centimeters away from the nodule, magnified 540 diam eters Both sections are stained with hematoxylin and eosin

Postoperative Course —Following the operation the patient no longer complained of pain in his lower extremities The wound healed promptly and the patient was discharged on the thirteenth postoperative day During the month following discharge the patient regained sphincter control and began to walk, at first holding on to things Apparently, however, at this time he was overactive, because subsequently pain recurred in the lower extremities and the patient did not walk for about a month Since this time the patient has constantly improved in the use of his lower extremities However, urinary incontinence has recurred, although rectal control is good When last seen, in February, 1937, the patient walked and ran easily although he kept his trunk flexed forward on the pelvis There was a weakness of the dorsiflexors of the right ankle Sensory examination and tendon reflexes were normal

Microscopic Examination —Smear of the fluid removed at operation revealed many large, flat, polyhedral cells, frequently joined together in groups of six or eight The nuclei were small and evenly staining, the cytoplasm finely granular and very slightly eosinophilic It was concluded that these were squamous epithelial cells The nodule removed showed everywhere a stratified squamous epithelial lining of which only about half was cornified The dermis contained fat, hair follicles, and sebaceous glands (Fig

3) Marked gliosis was present in the contiguous portion of the spinal cord The portion of cyst wall removed at some distance from the nodule showed an uncornified, stratified squamous epithelium and only a thin layer of connective tissue beneath separating it from the sclerotic spinal cord No dermal structures were present in this portion

There can be little doubt that these findings represent a developmental defect in the cleavage of the surface and neural ectoderm similar in many respects to the developmental anomaly responsible for the development of extramedullary dermoid and epidermoid tumors elsewhere in the central nervous system and to the congenital dermal sinuses reported by Walker and Bucy[16] In this particular instance the bit of surface ectoderm responsible for the tumor has remained firmly attached to the neural groove and become enfolded within that structure upon its closure to form the neural tube and eventually the spinal cord It seems likely that the nodule composed of dermal and epidermal structures represents the original implant and that the cystic cavity and its lining of stratified squamous epithelium have resulted from secretion from the dermoid nodule and the progressive enlargement and lining of this cavity from the "mother" epithelium present on the nodule It is to be hoped that removal of the dermoid nodule will terminate this progressive process since extirpation of the epithelial lining of this large cyst was not feasible

Discussion.—In the 20 cases included by Gross[5] in his report, five were intramedullary (Chiari,[2] Ivanoff[7] Marinesco and Draganesco[9] Melnikoff-Raswedenkoff,[10] and Gross[5]) Only that of Ivanoff was a dermoid cyst It occurred in an anencephalic monster, extending throughout the spinal cord and bulb It is hardly comparable to the case herein described where there were no apparent congenital defects except the tumor in the caudal end of the spinal cord and minor changes in the caudal portion of the spine Twelve additional cases have been found in the literature to which the one here reported is added The cases of Bouchut and of Puech bring the total number of intramedullary epidermoid tumors to six Only the case of Ivanoff, that of Love and Keinohan, and the one presented here were intramedullary dermoid cysts Ten of the 13 cases involved the region of the conus medullaris and cauda equina Of the three cases in the upper thoracic region two were accompanied by spina bifida and congenital dermal sinuses

The similarity in structure and development of dermoid tumors and congenital dermal sinuses should be mentioned Both are due to improper separation of the neurectoderm from the surface ectoderm A congenital dermal sinus, a dermoid tumor, or a combination of both may develop, depending upon whether or not the portion of surface ectoderm present in the region of the neural tube, as an inclusion, retains an epithelial connection with the surface

SUMMARY.—A case of intramedullary dermoid cyst in a male child three years old is reported and the literature reviewed Epidermoid and dermoid tumors within the spinal canal are dysraphisms of the same general nature as congenital dermal sinuses

REFERENCES

[1] Bouchut, Dechaume, J, and Michailidis Kyste cholesteatomateux intramedullaire par dysembryoplasie nerveuse Lyon med 150, 694–697, December 18, 1932
[2] Chiari Centrales Choleastom des Dorsalmarkes Prager med Wchnschr, 39, 378–380, 1883
[3] Craig, J, and Mitchell, A Spinal Tumors in Childhood Arch Dis Childhood, 6, 11–16, 1931
[4] Delrez, L Kyste Dermoide Rachidien et Sarcome du Rein Chez le meme Enfant Liege med, 22, 1667–1675, December 15, 1929
[5] Gross, Sidney W Concerning Intraspinal Dermoids and Epidermoids, with Report of a Case Jour Nerv and Ment Dis, 80, 274–284, September, 1934
[6] Hipsley, P L Dermoid Cyst of Spinal Canal Australian and New Zealand Jour Surg, 2, 421, April, 1933
[7] Ivanoff, N S A Case of Cholesteatoma of the Spinal Cord J Neuropat i psikiat, Korsakova, Mosk, pp 80–81, 1903
[8] Love, J G, and Kernohan, J W Dermoid and Epidermoid Tumors of Central Nervous System Reprinted with additions from J A M A, 107, 1876–1882, December 5, 1936
[9] Marinesco et Draganesco Kyste Epidermoide Cholesteatomateux de la Moelle Épinière, Rev Neurol, 40, 338–355, 1924
[10] Melnikoff-Raswedenkoff, N Ubei epidermoide und dermoide Cholesteatome des Grosshirns und Ruckenmarks Deutsch Ztschr f Nervenh, 127, 123–130, 1932
[11] Naffziger, H C, and Jones, O W Dermoid Tumors of the Spinal Cord Arch Neurol and Psychiat, 33, 941–958, May, 1935
[12] Ottonello, Paolo Dermoide spinale associato a rachischisi Riv di pat Nerv, 41, 512–531, May–June, 1933
[13] Puech, P, Plichet, A, Visalli, F, and Brun, N Cholesteatome intramedullaire Rev Neurol, 66, 56–62, July, 1936
[14] Schroeder, A H Cholesteatoma medular An Frac de med Montevideo, 17, 591–616, August, 1932
[15] Shallow, Thomas A Dermoid Cyst of the Cauda Equina Surg Clin N Amer, 8, 885–889, August, 1928
[16] Walker, A E, and Bucy, P C Congenital Dermal Sinuses Brain, 57, 401–421, December, 1934

TEARS OF THE SUPRASPINATUS TENDON

RESUME OF TWELVE OPERATED CASES

TOM A OUTLAND, M D, AND WALTER F SHEPHERD, M D
SAYRE, PA

IT WOULD seem almost unnecessary, in view of the complete and painstaking monograph of Codman, to attempt to present additional material on lesions of the supraspinatus tendon, but because of the scarcity of medical literature dealing with this subject and the fact that we believe that the diagnosis of such injuries more often than not goes unrecognized, we are presenting a brief and admittedly incomplete resume of the salient points in the condition of supraspinatus tendon tear in conjunction with a report of a group of cases operated upon by the senior author

Between 1928 and 1934, we diagnosed this condition three times, since 1934 we have seen and diagnosed 14 cases in this clinic, of which 12 have come to operation, at which time the lesion was demonstrated and a repair of the tendon effected It would appear from what we have learned in these recent cases, that we have previously seen other instances, many of them less well defined symptomatically, without recognizing the real condition, and for this reason we wish to emphasize the necessity for careful study of all obscure cases of shoulder dysfunction

Anatomy—The tendinous insertion of the supraspinatus, together with the infraspinatus, teres major and teres minor (forming the musculotendinous cuff) is closely attached to the capsule of the shoulder joint reinforcing the latter in its upper half While standard anatomic text-books state that the supraspinatus is inserted into the upper facet of the greater tuberosity, it is so intimately blended with the contiguous infraspinatus as to be indistinguishable from it

Its function is to pull the greater tuberosity under the acromion, fix the humeral head in the glenoid, and abduct the shoulder through the first few degrees, at which point the deltoid assumes the burden and continues the motion throughout the arc of scapulohumeral motion

Etiology—Rupture of the supraspinatus, though certain factors may predispose to it, is traumatic in origin The injury apparently may occur in one of two ways—either in falling the patient abducted his arm in an attempt to break the fall, the rupture occurring during the movement before the shoulder struck the ground, or a direct blow (or fall) was received on the back of the shoulder with production of a forward displacement of the humeral head with consequent rupture of the tendon Dislocation of the shoulder may occur or the displacement may be only momentary, followed by spontaneous replacement

Submitted for publication March 4, 1937

According to Codman and Akerson[4] the tendon may have been previously weakened as the result of (1) Defects left as a result of so called calcified deposits, (2) necrosis of the tendon or other diffuse pathologic process or of the same phenomena which are known as arthritis in other joints, (3) attrition Finally, age may be considered as a predisposing factor since the condition is commonly seen in patients around or beyond the fifth decade

PATHOLOGY —The site of rupture of the supraspinatus is commonly at, or very close to, the greater tuberosity The proximal fragment then retracts, enlarging the gap and frequently tearing the floor of the bursa, thus creating an opening through which there is a direct communication between the bursa and shoulder joint

Diagnosis —The fact that in no instance when a diagnosis of supraspinatus tear was made have we been unable to demonstrate the lesion is good evidence that the symptomatology is clear cut Codman has outlined 18 conditions, symptoms, and signs which indicate complete rupture of the supraspinatus Of these, we have found the following objectives signs of greatest importance

(1) Diminution or loss of the power to abduct This varies with the size of the tear and also with the nervous make-up and fortitude of the patient

(2) Tenderness over the greater tuberosity Dawbarn's sign has not been of especial help, since there may be hyperesthesia in the distribution of the circumflex nerve

(3) Undue prominence of the greater tuberosity due to the fact that its tendinous covering is absent

(4) Crepitus of a fine nature, palpable over the tuberosity as it moves under the acromion on passive motion of the arm

(5) A negative roentgenogram

Description of a Typical Lesion —In Wilson's[3] cases all the tears were of the complete type, the largest rent measuring two and one-half inches and involving the subscapularis and infraspinatus tendons as well The commonest tear measures about one and one-half inches, is roughly triangular in shape with the base toward the greater tuberosity and the apex of the tear may extend up under the acromion, especially in old cases The underlying joint capsule is nearly always torn through exposing the inside of the joint The edges of the tendon are ragged and thinned, and calcification may be present in the cases of long standing As a rule, very little tissue remains attached to the greater tuberosity The head of the humerus is unaffected in the early case In the average case the insertions of the other short muscles are unaffected If dislocation occurs, however, rupture in varying degree may be present in the adjacent structures

Treatment —The treatment, unless the tear be very small, is operation and suture of the tendon There is reason to believe that incomplete tears may be successfully treated by rest in abduction

We have under treatment at the present a patient with classical symptoms

of a tear, but in view of the fact that considerable power in abduction was retained, treatment on an abduction splint was advised Rest in abduction was carried out until the crepitus disappeared (four weeks), when active motion was started Progress has been slow and, while the outcome is apparently going to be satisfactory, we feel that operative repair would have shortened the convalescence

For the complete tear with wide separation, operative repair is the only logical treatment Usually it is possible to attach the retracted tendon to the tuberosity by one of several methods Anatomic approximation of the retracted ends and suture with two or three heavy silk mattress sutures is probably the best method and is generally possible in early cases In the older case where the edges of the tear are ringed with scar tissue, the latter may be excised back to normal tendon, or the sutures may be placed well back in healthy tendon tissue so that the necessary tension can be applied when approximating the fragments We have preferred this to the former procedure If there is insufficient tendon attached to the tuberosity to permit simple suture, a groove may be cut in the tuberosity and the proximal portion of the tendon drawn close to the groove and anchored by mattress sutures passed through drill holes made through the tuberosity into the groove In the older case with such wide retraction that suture is not possible, the remnants of the attachment can be removed and the enlarged and irregular tuberosity may be removed to prevent impingement of the tuberosity on the acromion during abduction This was done in one case with good results so far as relief of pain was concerned, but with, of course, no improvement in strength

Following operation the arm is immobilized by the use of an axillary pad, sling and bandage As soon as the wound is dry, sinusoidal current and "bending" exercises are begun The latter consists of allowing the arms to hang loosely at the side and then bending forward In this manner a position of abduction is obtained without muscular effort At the end of three weeks, supported active motion and active exercises on the finger ladder and the use of a weight and pulley are started Improvement generally extends over a period of from three to six months

The following resume of 12 operated cases is presented The results have been classified as excellent, good, fair and poor This classification is, of course, arbitrary, but in general the descriptive terms mean as follows Excellent—complete relief of pain and from 75 to 100 per cent return of power of abduction, good—pain relieved, active abduction present but considerably weaker than normal, fair—relief of pain, abduction very weak, poor—little or no relief from pain or increase in power of abduction

CASE REPORTS

Case 1—S O, female, age 46, while lifting a heavy object from a shelf felt something snap in her shoulder, which became very weak and painful Chiropractic treatments did not afford relief Operation was performed 14 months later Operative

Findings Complete tear of supraspinatus tendon, floor of bursa, and capsule Approximation of the tendons was possible Repair with mattress sutures Result Good

Case 2—J L, male, age 59 No definite injury Does heavy labor Pain began one week ago Was unable to abduct arm No treatment Kahn test four plus Operative Findings Floor of bursa thick and red but not torn, complete tear of supraspinatus tendon and long head of biceps Both repaired Result Good

Case 3—C K, male, age 69 Fell from roof 18 hours previously, striking on shoulder Typical findings of complete tear, floor of bursa torn, bursa filled with synovial fluid, complete tear of supraspinatus tendon Result Four months after operation, good and still improving—probably the eventual result will be excellent

Case 4—F W, male, age 59 Fell three days previously while getting on passenger coach and attempted to break his fall by grasping hand rail No treatment Patient known diabetic Operative Findings Typical complete tear one and one-half inches long involving both supraspinatus and infraspinatus tendons equally, floor of bursa not ruptured Result Good

Case 5—M S, male, age 32 Dislocated shoulder (caught under coal slide December 17, 1934) Shoulder quite weak and stiff Twice manipulated under anesthesia for peri-arthritis Passive motion increased but no active abduction and much pain Operation August 29, 1935 Operative Findings Bursa not torn, section of bursa discolored and appeared cystic on palpation, floor incised and triangular tear seen, part of superficial fibers intact but thin, deep fibers ruptured Result Fair

Case 6—N D S, female, age 60 Both shoulders dislocated and reduced by manipulation Right shoulder remained weak in abduction but not painful Treated by massage Operated upon 14 months later Operative Findings Bursa open, small tear near insertion easily repaired, but about one inch proximally was a large tear involving the supraspinatus and infraspinatus tendon with edges widely retracted Result Fair (seen only for six weeks postoperatively)

Case 7—L L, male, age 52 Struck by falling barn door one week before examination Pain not prominent, such pain as was present referred to deltoid insertion Unable to abduct arm and tender over tuberosity (latter very prominent) No treatment Operative Findings Bursal floor torn, complete tear of supraspinatus and infraspinatus tendons, insertion much frayed, biceps not ruptured Result Excellent

Case 8—J K M, male, age 54 Fell from derrick Severe pain and inability to abduct Treated with physiotherapy Operation performed seven weeks later Operative Findings Floor of bursa thick and rough but intact, complete tear with wide retraction, very few shreds at insertion Impossible to approximate tendon and tuberosity removed Result Fair, pain relieved, no power in abduction

Case 9—T H, male, age 57 Fell from box car two days before operation Pain referred to insertion of deltoid, weakness in abduction Operative Findings Floor of bursa intact, tuberosity very prominent, area of yellowish discoloration about this, when floor of bursa was incised, a triangular tear three-quarters of an inch wide was seen, yellowish discoloration due to degeneration of tendon about the margins of the tear, yellowish material not amorphous but fibers of tendon apparent in it Result Excellent after five months

Case 10—D A, male, age 56 Auto accident 24 hours previously Fracture dislocation of shoulder Open reduction effected Operative Findings Complete rupture of supraspinatus and subscapularis, long head of biceps intact Result Excellent

Case 11—B C, male, age 42 Knocked down by horse eight days previously Dislocated shoulder Shoulder reduced No return abduction, tender over tuberosity Operative Findings Small triangular tear in supraspinatus tendon, bursa not open Good approximation secured Result Good

Case 12—J K, male, 42 Thrown from auto Dislocation shoulder and fracture greater tuberosity Treated by reduction of dislocation and physiotherapy to the shoulder

Loss of abduction, not much pain, no crepitus in passive abduction Operation seven weeks later Operative Findings Bursa scarred and adherent to tendons, old triangular tear (small), either incomplete or, more likely, filled in with scar Result Poor

COMMENT—While we are inclined to be cautious in attempting to draw definite conclusions from this small series of cases, the following points seem worthy of emphasis

(1) Complete tear of the supraspinatus tendon is apparently possible without producing a rent in the floor of the bursa Case 4 illustrates this well The tear was one and one-half inches long and situated about three-quarters of an inch from the tuberosity and involved the supraspinatus and infraspinatus tendons to an equal degree While the edges of the tear were not widely separated with the patient relaxed under anesthesia, the tear was complete and involved the capsule as well Yet the overlying bursa was intact, although the floor was quite hemorrhagic In view of the foregoing, it appears that an exploration is not complete unless the floor of the bursa is incised and the tendon visualized

(2) Five of our operated cases were the result of shoulder dislocation It may be concluded that the belief expressed in certain text-books that the subscapularis is occasionally torn but that other tendons are rarely ruptured, is open to question Certainly the practice of testing all patients with dislocated shoulders for the ability to actively abduct immediately after reduction is effected is desirable

(3) The presence of constitutional disease (lues or diabetes) in two of our cases is interesting and suggests that systemic disease may be a predisposing factor in supraspinatus tendon tears

(4) The presence of the degenerative changes in the torn tendon noted in Case 9 may bear out Codman's belief that the calcification found in so called subacromial bursitis with calcified deposits in the tendon represents slight supraspinatus tendon tears which nature attempts to repair The alternative conclusion is that the deposit preceded and predisposed to the tear Against this latter is the fact that the patient previously had had no complaint referable to the shoulder Furthermore the yellowish material was not the usual cheesy or (in older cases) tartar-like substance ordinarily found in instances of bursitis, since tendinous fibers could still be identified in the substance

(5) While the average age of our patients was 50 years, Case 5 was a robust miner of 32 Thus, the diagnosis cannot be absolutely ruled out on the basis of youth

SUMMARY

(1) Rupture of the supraspinatus tendon is a common lesion

(2) It occurs most frequently in laboring men over 40

(3) The lesion presents a characteristic history with well defined physical findings

(4) Continued shoulder disability following any trauma should be considered a general indication of rupture

(5) Complete separation of the tendon demands surgical repair

REFERENCES

[1] Codman, E A The Shoulder Boston, Mass, Thomas Todd Company, 1934
[2] Keyes, E L Observations on Rupture of the Supraspinatus Tendon ANNALS OF SURGERY, 97, 849, June, 1933
[3] Wilson, P D Complete Rupture of the Supraspinatus Tendon J A M A, 433, February 7, 1931
[4] Codman, E A, and Akerson, I B The Pathology Associated with Rupture of the Supraspinatus Tendon ANNALS OF SURGERY, 93, 348, January, 1931

DUPUYTREN'S CONTRACTURE *

A BRUCE GILL, M.D.
PHILADELPHIA, PA.

ALTHOUGH the literature is voluminous, our knowledge of the etiology and the cure of Dupuytren's contracture has not been particularly advanced during the past 20 years. Eighteen years ago the author[1] read a paper on this subject before the Philadelphia Academy of Surgery. To this paper but little can be added today.

Etiology.—The etiology may be considered with reference to exogenous factors, or trauma, and endogenous factors, or the very numerous conditions or agents which produce biochemical changes in the palmer fascia, or to a combination of these two groups of factors.

It cannot be denied that in a small group of cases there is a hereditary tendency to Dupuytren's contracture. Many authors have spoken of it, one cites an instance of 17 cases in 53 members of one family during a period of three generations. The author has a patient with bilateral Dupuytren's contracture whose two brothers, and a grandmother, two aunts and one cousin on his father's side have the same condition. These facts, of course, do not explain the etiology. They simply point to some unknown hereditary, constitutional factor as the cause and demonstrate the irrelevance of trauma as the chief factor.

Trauma, acute or chronic, cannot be considered as a prime factor but only as a possible contributing or exciting cause of fibrositis of the palmar fascia. One author found this condition in only four of 21,800 manual laborers, another in only five of 2,000 industrial workers. Meyerding, of the Mayo Clinic, in reporting Dupuytren's contracture in 273 patients found 45 per cent occurred in farmers and laborers, and 55 per cent in mental workers. These figures would have a definite meaning only if we knew the relative number of manual and mental workers treated at the Mayo Clinic as a whole. In his cases the contracture was bilateral in 64 per cent. Of the unilateral cases 70 per cent occurred in the right hand. The average age of his patients was 54, the youngest 17 and the oldest 80.

We may conclude in part with Davis and Finesilver that trauma is not a prime factor because

(1) The onset is usually after middle life, even in individuals who have been doing hard manual labor from their youth up.

(2) It is by no means confined to manual laborers and is comparatively uncommon in them.

(3) It is more often bilateral than unilateral. In the use of tools and

* Read before the Philadelphia Academy of Surgery, February 15, 1937. Submitted for publication April 19, 1937.

implements there is usually more pressure and strain placed on the palm of one hand than upon the other

(4) The ulnar portion of the palmar fascia is most commonly affected, while it is at least doubtful if this portion of the palm is more subjected to injury than the remaining portion

(5) Trauma to the hand, both acute and chronic, is common, while Dupuytren's contracture is rare

Yet it must be borne in mind that trauma may be an inciting or contributing factor in Dupuytren's contracture in certain cases, as it undoubtedly is in some cases of acute and chronic arthritis, myositis and fibrositis in other parts of the body

We are reduced to the conclusion that Dupuytren's contracture is essentially of endogenous origin Some change occurs in the metabolic or *biochemical processes taking place in the palmar fascia which produces an* inflammatory reaction with the consequent production of scar tissue This reaction may be acute and manifested by fairly rapid swelling, redness, tenderness and pain on function The author has observed this in his own left hand and has seen it in other persons Usually, however, the inflammation is chronic and insidious, although there are often alternating periods of exacerbation and remission

There are many etiologic factors in the production of chronic inflammations in various parts of the body They are often more active with the degenerative processes that accompany advancing age Dupuytren's contracture bears an interesting resemblance to chronic arthritis although it has no direct relation to diseases of joints One observer found arthritis present in only 10 per cent of 40 cases of Dupuytren's contracture The factors which cause the arthritides are numerous and they cannot always be determined in every case But we have come more and more to the realization that many conditions which produce a disturbance of the normal metabolism of the body may cause arthritis Of these conditions, focal infections occupy a prominent but not an exclusive place The author has seen cases of Dupuytren's contracture which appeared to be directly connected in their origin and their clinical course with focal infections One patient had a chronic suppurating osteomyelitis of the jaw During this period he developed an acute arthritis of one ankle and about the same time a beginning Dupuytren's contracture of the right hand In two patients with subacute palmar fibrositis the condition improved markedly after the extraction of dead teeth which had apical abscesses in whom no exacerbation or extension of the disease occurred subsequently Meyerding reports the presence of focal infections in 141 of his 273 cases One author found Dupuytren's contracture occurred more frequently in diabetes than in any other constitutional disease Pemberton, as is well known, has found disorders of sugar metabolism in many cases of arthritis

Dupuytren's contracture has been noted frequently in cases of syringomyelia and has been ascribed to a trophoneurotic lesion One author believes that

Dupuytren's contracture is the result of a funiculitis or a neurodocitis of the extrameningeal tract of the sympathetic nerve between the ganglion and the plexus The cause of this condition is a cervical arthritis He believes that it is a trophoneurotic lesion, but not necessarily of rheumatic origin It is known that in arthritis there is marked disturbance of the circulation about the joint which may be a primary vasomotor disturbance and not merely a condition secondary to the arthritis

Hale Powers, a neurologist, has reported 29 cases which he discovered with few exceptions in making neuropsychiatric examinations for the U S Veterans' Administration Many of these were cases of neurosis Many had been gassed A number of them had pulmonary tuberculosis He came to the conclusion that Dupuytren's contracture is due to an overexcitation or hyperactivity of the sympathetic ganglia This results in atrophic disturbances at the periphery Some of the cases of Dupuytren's contracture were associated with hypertrophic osteo-arthropathy of the fingers, scleroderma and multiple chondromata He ascribes all of these peripheral manifestations to the one cause and believes that in his cases the sympathetic hyperactivity could be ascribed to upper pulmonary disease He agrees with Janssen that Dupuytren's contracture is not inflammatory in its pathology but is a hyperplasia of the connective tissue of the palmar fascia This view of the pathology is contrary to the usually accepted opinion of its being a chronic inflammatory process I have seen cases which presented the ordinary signs of inflammation such as a fairly acute onset, swelling, tenderness and redness of the overlying skin Furthermore, hyperplastic normal fascia should show no tendency to contraction such as is found in Dupuytren's contracture

We may possibly grant the opinion that visceral disease is an etiologic factor in a certain group of cases such as those observed by Powers, but certainly we see many cases of Dupuytren's contracture in which there is no evidence of such visceral disease

Fibrositis is one of the elements in the pathology of chronic arthritis Arthritis and Dupuytren's contracture are not infrequently found together in the same individual, and it is possible that the coincidence would be higher in the statistics had all patients with Dupuytren's contracture been examined carefully for arthritis, however incipient and mild Does it not seem possible that the same causes which cause fibrositis about a joint or in fascia of the back or in bursae may cause a fibrositis of the palmar fascia which is a very active structure of the hand and is subject to the wear and tear of almost constant use and which is subject to the degenerative processes of old age?

How the various etiologic factors produce the pathologic changes which occur in chronic arthritis we are not certain There is some reason to believe that the changes occur in the structures in and about the joint because of primary disturbance of the blood supply It may be possible that this primary disturbance occurs through the vasomotor system

It is interesting to quote from my former paper on this subject an opinion of Kenneth Black[2] that he believes that "It, Dupuytren's contracture, will eventually be recognized to be due to a certain internal condition (possibly akin to gout or rheumatism) among persons of advancing years"

The many observations made by various writers on the etiology of Dupuytren's contracture during recent years, only a few of which I have touched upon, should lead us to take a broad point of view as to the origin of this condition It is probably not an entity in itself It is more probably due to one or more of many constitutional conditions Local traumatism, if it has any influence, plays but a secondary part as an inciting or inducing factor

Treatment—Excision of the palmar fascia offers the only means of complete cure, but a number of considerations should determine our judgment as to the necessity or the time for operation The author very decidedly disagrees with Meyerding's dictum that all cases should be operated upon and the earlier the better The method of operation which offers the best chance for a successful result must also be determined

Dupuytren's contracture passes through a series of stages during its course of development The ulnar portion of the fascia is first affected, most commonly that portion which extends to the fourth digit It may begin acutely as mentioned in the first part of this paper, or may develop very slowly and escape particular attention for a long period There is no contracture of the fingers and not the slightest interference with the function of the hand during this stage Some cases never progress beyond this point The patient should be treated by eradication of focal infections and the correction of any constitutional disorder which might have any possible bearing on the metabolic processes of the body In a general way he should be treated in much the same way as you would treat a case of incipient arthritis by searching for the possible etiologic factors and by removing them Operation is contraindicated for the following reasons (1) The function of the hand has not been impaired (2) The contracture may never progress It may even regress if you can remove the constitutional causes (3) If the case is a progressive one, the fibrosis may extend after operation to other parts of the fascia unless you excise the entire palmar fascia, including its extensions as far as the second phalanges of all the fingers Indeed, the progress of the case may be accelerated by the traumatism of the operation The author operated upon a case, in 1923, by excising the entire fascia from the little finger over to and including the index finger To his dismay the patient rapidly developed a fibrosis of the entire hand with a resulting permanent partial ankylosis of all the joints of the fingers and thumb and of the wrist, and was accompanied by a marked thickening of the palmaris longus tendon above the wrist He had failed to investigate etiologic factors before operating The patient had had an abscessed tooth extracted several weeks before operation A later examination of the tonsils

revealed that both of them retained in their crypts a very large quantity of cheesy, purulent secretion

During the second stage of this disease the fibrosis extends toward the radial side of the hand and toward the fingers There may be a beginning contracture of the fourth finger, then of the fifth, and even of the third Here also the condition may become stationary and may not impair the function of the hand Within the past year a dentist came to me from another city, having made all preparations to remain for operation He had a Dupuytren's contracture of six years' duration It involved the fascia of the fourth and fifth fingers but without contracture of the fingers His tonsils and one devitalized tooth had been removed a year ago He had observed no progress of the condition for the past year It did not in the slightest degree interfere with his work as a dentist I told him I should not operate upon him A look of amazement and of pleasure spread over his face He said, "I am going over to New York and have a good time I haven't had a vacation in 20 years" I advised him as to a careful search for focal infections, told him to return if the condition should progress and become annoying, and sent him on his way rejoicing

In the third stage there is marked contracture of one or more fingers and the function of the hand is seriously impaired Operation should be recommended, but, again, only after careful search for the etiologic factors and after their removal if possible

The author employs the operation he recommended 18 years ago, a complete excision of the fascia through an incision in the distal palmar crease and through the creases at the base of the finger and at the proximal interphalangeal joint if it is necessary to excise the digital extensions of the palmar fascia At that time he employed and advised the transplantation of a small piece of fat, from the abdomen or thigh, beneath the skin of the palm In his operations during recent years he has omitted from the procedure the transplantation of fat and is at present undecided as to its value But the use of an incision along the line of a natural crease rather than counter to it requires no argument Various surgeons who have reported cases operated upon by flap incision or by vertical, elliptical, oval or semioval incisions have had some cases of sloughing of skin which required skin grafting later The author has never had this accident occur following the transverse incisions along the creases of the hand and the fingers Dissection of the skin from the underlying fascia without making button holes is probably more difficult than through other incisions, but it can always be accomplished by exercising due care and patience It is never necessary, even in the severe cases, to excise a portion of the skin of the palm and replace it with a graft

The operation is performed most easily by using a tourniquet about the arm and under general anesthesia The incisions are closed with interrupted silk sutures The hand, with the fingers extended, is dressed on a well padded palmar splint until the wounds are healed Baking and massage

of the hand and fingers are begun after two weeks if there is any indication for their use

REFERENCES

[1] Gill, A Bruce Dupuytren's Contracture, with a Description of a Method of Operation ANNALS OF SURGERY, 70, 221, August, 1919
[2] Black, Kenneth Brit Med Jour, 50, 326, 1915

DISCUSSION—DR JOHN HOMANS (Boston) noticed that Doctor Gill had said nothing about this disease occurring in women However, they are subject to it, though in very much smaller numbers than men, just as they do not suffer as much as men from circulatory diseases in the extremities As to the treatment of this condition, Doctor Gill had not considered roentgen therapy He knew of one patient who has an incipient disease of this sort, who finds that if he has a moderate exposure the condition improves He was especially interested in the effect of early operation and thought Doctor Gill's argument very strong In the face of a disease whose etiology is so poorly understood his theory was certainly very sound He had had an adventure with one case—it may or may not have been Dupuytren's contracture—but the patient had a contracture of the palmar fascia leading to the little finger He did not recall that it showed any inflammation The fascia was dissected out without any particular difficulty and the only thing noticed was that it was unusually adherent to the underlying tissues After the operation the hand was placed in a splint, the finger at first remained straight, but as soon as the splint was removed it turned right up The newly formed scar tissue seemed actually thicker than the original and he felt that the operation had done more harm than good The patient sued him At the time, however, thinking that he had done the right thing, he defended himself very vigorously

As to the use of fat He used a couple of fat transplants and found it difficult to secure healing without more induration and thickening and felt it to be undesirable The cases were no worse off but they were certainly no better

DR A BRUCE GILL in closing stated that he had not discussed any methods of treatment except excision of the palmar fascia Multiple incision of the fascia (fasciotomy) with subsequent splinting of the hand as devised by Adams and employed generally for years was ineffective in securing a complete or a permanent cure and frequently resulted in marked fibrous ankylosis of numerous joints of the hand and fingers Doubtless many of these patients had a chronic arthritis of these joints Roentgen therapy, injections of fibrolysin and other conservative methods of treatment likewise cannot be relied upon to improve or remove the deformity Excision of the palmar fascia was the only method of cure

GLOMUS TUMOR

GLOMANGIOMA

ANATOLE KOLODNY, M D , PH D
NEW YORK, N Y

DURING the past decade there have appeared in the literature case reports of patients who had suffered for years from a painful nodule somewhere about the body, most frequently about the upper extremity, who had been cured by its removal The histogenesis of these tumors was easily established and, because its origin was traced to the subcutaneous glomus, it was named glomus tumor, or better, glomangioma, as suggested by Bailey [1]

While the histologic structure of this growth is now well known, its clinical behavior and course are not fully established A characteristic clinical picture and the typical pathologic findings observed recently in a case of glomangioma of a finger justify its report here Sweating of the finger appearing upon irritation of the nodule adds to our knowledge of the physiology of sweating

Case Report—A female, white, age 22, commenced feeling a pain over the palmar aspect of the distal phalanx of the right middle finger At first the pain was mild and she felt it only on hitting the piano key while playing Later on the pain became much more severe and appeared on the slightest provocation Mere touch of the finger tip pressure on the nail of the finger, or a sudden change of the temperature ushered in an episode of pain These seizures consisted of three phases a preliminary slight pain followed at once by the appearance of beads of perspiration over the palmar aspect of the terminal phalanx of the finger, followed by a sharp, burning, stabbing pain referred to the finger tip, which radiated rapidly through the ulnar half of the hand, forearm and arm to the precordium This produced a sensation of "pulling" in the finger that was followed by a tired feeling in the right hand The pain would then suddenly disappear and after a few seconds be succeeded by a new attack, of much lesser intensity Thus, the episodes would gradually wear away leaving the patient exhausted If the provoking stimulus was very severe the attacks that followed were correspondingly more severe, greater in number and more rapid in sequence The terminal phalanx of the middle finger remained normal in all respects with the exception of having a much softer skin, as a result of habitual guarding of the finger against contact with any object The patient's condition was not recognized for years and she was frequently considered a psychoneurotic

Examination—First examined by the author ten years after the onset of the pain On inspection, there was nothing abnormal about the right hand However slight pressure with the tip of a lead pencil over one point on the palmar side of the finger tip provoked an attack, followed by the many subsequent subjective sensations as previously outlined Objectively one saw the appearance of fine beads of perspiration over the palmar aspect of the terminal phalanx These appeared five to six seconds after the pressure of the pencil This pressure point was about 1 cm from the finger end and 0 25 cm laterally from the midline of the palmar side, pressure on points even only 0 25 cm away provoked no attack

Operation—Under block anesthesia with novocain, a flap of the palmar skin and

Submitted for publication April 21, 1937

subcutaneous tissue of the terminal phalanx of the finger was turned up A dark bluish, spongy nodule was discovered at the pressure point described above This nodule measured 0 2×0 3 cm but rapidly increased to twice this size when it was touched with a forceps Two thin thread-like blood vessels were attached to the nodule, one at each end of it The growth was just beneath the subcutaneous tissue, between it and the underlying bone It was there unattached to the neighboring structures and it shelled out easily from its niche-like resting place The skin flap was sutured back in place The wound healed readily and there was no disturbance of sensation or disfigurement of the finger tip One month after the operation the patient was able to play the piano freely for the first time in years

Pathologic Examination.—The nodule presented a ball of contorted blood vessels, resembling in their structure the vessels of the cutaneous glomus (Fig 1) Some vessels were surrounded by a layer or two of smooth muscle fibers, with a fine collagenous membrane intervening between them and the endothelial lining of the vessels (Fig 2) Hugging the muscle fibers were groups of large cells with a scanty cytoplasm and densely staining nuclei About them were seen abundant endothelial cells with pale large vesicular nuclei and deeply staining nucleoli These polygonal cells are the characteristic glomus cells Other vessels lack the smooth muscle fibers but are densely surrounded by glomus cells (Fig 3) The glomus cells are in intimate contact with numerous nonmyelinated nerve fibrils which are easily traced to the larger periglomic fibers The entire mass of contorted vessels is enveloped by dense collagen fibers, which, broadly taken, might be considered a capsule of the nodule

One of the two blood vessels attached to the poles of the nodule presented a normal histologic structure of an artery, while the other appeared as a vein Thus, the nodule strikingly resembled the anastomotic unit of a peripheral arteriovenous anastomosis We have here the afferent artery, the contorted Sucquet-Hoyer canal, with the neuroreticular and vascular structures about it, and the collecting vein

COMMENT.—While this condition has been known for centuries, the lesion has attracted a great deal of attention only of late Because of its rarity, most recent reports in the literature are based upon groups of cases assembled from clinical records that were prepared long before the true nature of the lesion was known Thus, while the excellent histologic reports are based upon recent studies of the available tissue material, the quoted old clinical reports are not complete and are at times inaccurate and misleading

A generally accepted error is the description of the lesion as a "purplish-blue discoloration of the skin, mounted on top of a small cutaneous elevation"[1,2] The fact that the condition frequently remains unrecognized for years proves the fallacy of this description In the present case there was neither a discoloration of the skin nor any palpable or visible elevation or dimpling of it This error is based upon a faulty presumption that the nodule is always situated "subepidermally," as stated by Stout[3] Originating from the subcutaneous glomus, situated in the reticular area of the skin, this overgrowth may expand toward the epidermis, and become visible by its discoloration of the overlying skin, or it may extend beneath the subcutaneous tissue, as in the present case, without any discoloration of the skin

The present knowledge of the nature of the lesion suggests the proper surgical approach to it, especially when it is situated about the finger tip—its most frequent site The approach must be one that will expose the nodule and at the same time will not disfigure the finger or interfere with

Annals of Surgery
January 1938

Fig. 1.—Photomicrograph of a cross section of the glomangioma. The afferent artery, a nerve trunk and a section of subcutaneous fat tissue are seen attached to one end of the nodule (low power).

Fig. 2.—Photomicrograph of a vessel in the glomangioma. It is surrounded by a few muscle fibers and numerous epithelioid cells (high power).

Fig. 3.—Photomicrograph of a vessel showing the absence of muscle fibers, the glomus cells are hugging the endothelium of the vessel (high power).

its sensation Such an approach is the one used in this case It obviates failure to locate the lesion and the necessity of repeated operations, as observed in Cases 1 and 4 of the group reported by Lewis and Geschickter [4]

Since a glomangioma is merely an organoid overgrowth of the normal cutaneous glomus, retaining its physiologic functions, the appearance of beads of sweat on the terminal phalanx of the finger during a paroxysm of pain is of physiologic importance Our present conception of the physiology of sweating is crowded with numerous hypotheses Dieden[5] and others believe in a central nervous system control of sweating, with special stimulating and inhibitory nerve fibers supplying the sweat glands In support of this view the observation of Rowntree and Adson is quoted that after sympathectomy and ganglionectomy, sweating is abolished Adamkewich[6] goes even further In addition to a spinal cord sweat center he accepts a reflex path by way of the spinal cord to the brain Thus he explains the known observation of bilateral sweating of the hands following unilateral irritation of the skin In general, it is considered that sweating cannot occur without the necessary nerve stimulus, and that the sweat glands are not subject to direct stimulation

One could with difficulty account for the sweating in the present case as a result of a sensory reflex (pain—spinal cord—sweat glands), since sweating was limited to the terminal phalanx, while the provoked pain extended all along the extremity The marked dilatation of the component blood vessels of the glomangioma upon irritation, as observed during the operation, led to a pathologic exaggeration of the physiologic function of the cutaneous glomus This function is the regulation of the general temperature of the body, when fully opened the cutaneous glomus aids the dispersal of heat by allowing an increased flow of blood to pass through it But in a local pathologic exaggeration of this function, as in a glomangioma, this dilatation induces local sweating as an additional means to achieve a dispersal of heat It seems, therefore, that the general tendency to place the sweat glands under the sole control of the central nervous system is too narrow, and some autonomy must be granted the sweat glands in their function

REFERENCES

[1] Bailey, O T Cutaneous Glomus and Its Tumors Am J Path, 11, 915, November, 1935

[2] Jirka, E J, and Scuderi, C S Glomus Tumor J A M A, 107, 201, July 18, 1936

[3] Stout, A P Tumors of the Neuromyo-Arterial Glomus Am J Cancer, 24, 255, June, 1935

[4] Lewis, Dean, and Geschickter, C F Glomus Tumor J A M A, 105, 775, September 5, 1935

[5] Dieden Klinische und experimentelle Studien uber die Innervation der Schweissdrusen Deutsch Arch klin Med, 117, 180, 1915

[6] Adamkewich Die Sekretion des Schweisses Berlin, Hirschwald, 1878

INTERNAL FIXATION FOR RECENT FRACTURES OF THE NECK OF THE FEMUR*

MILLVIN S HENDERSON, M D
ROCHESTER, MINN
SECTION ON ORTHOPEDIC SURGERY, THE MAYO CLINIC

A FRACTURE of the hip is often the death blow of the elderly patient Fractures involving the trochanter unite readily, although deformity and shortening are common, whereas fractures of the femoral neck are notorious for their failure to unite It is the latter group that I shall discuss in this paper

The average mortality rate among patients admitted to hospitals for treatment of fractures of the neck of the femur is about 15 per cent The rate runs higher in some of the hospitals where the derelicts of the large cities are cared for, and most probably in the sparsely settled sections of our country where hospital facilities are not available

If patients who have fractures of the neck of the femur can be assured of a better chance of a good result by operative treatment, with no greater mortality risk they should be operated upon In our experience at The Mayo Clinic the operative treatment carries no higher mortality rate than treatment by nonoperative, conservative measures provided the operation is performed ten days or more after the injury Most of the deaths incident to fracture of the neck of the femur occur in the first week or ten days If the patient survives that dangerous period, the treatment, either conservative or operative, can be undertaken with comparative safety Immediately following the accident a Thomas extension splint or simple Buck's extension traction may be used to steady the leg and ease the pain Some patients, manifestly, can stand no real treatment and the life of the weak, debilitated, elderly individual simply ebbs away

There is no need for haste in reducing the fracture for one can safely observe the patient for from ten days to three weeks before reduction of the fracture is undertaken, provided traction is maintained, with no appreciable disadvantage accruing Pain can be controlled by the traction and by administration of opiates If the Whitman method of treatment is used, the patient faces three months of fixation in a plaster spica cast Operative treatment, with internal fixation by metal, has the very decided advantage that the plaster spica either can be dispensed with entirely or worn for only a few weeks and then movement instituted

In The Mayo Clinic we have obtained in the past, by the Whitman method, approximately 65 per cent bony unions in those cases in which patients were

* Read before the meeting of the Louisiana State Medical Society, Monroe, Louisiana, April 26–29, 1937 Submitted for publication June 2, 1937

less than 60 years of age and about 54 per cent bony unions in those cases in which patients were more than 60 years of age Three months or more of confinement in a plaster spica, and the sequelae of stiff knees and hips, is a hardship and ordeal for patients and all others concerned The method of fixation by use of a nail, reported by Smith-Petersen[9] in 1931, not only gives a higher percentage of bony unions but convalescence is easier and shorter Since 1933, we have used either the Smith-Petersen nail or the lag-screw in the treatment of all patients with fresh fracture of the neck of the femur whom we considered presented reasonably good surgical risks

Operative treatment of fracture of the neck of the femur is not new It has been urged by various surgeons in the past but Smith-Petersen was the first carefully to report cases He advocated use of a triple flanged nail and there were included in his report enough records of cases, followed through to completion, to give his report real worth Following this, various devices for fixation have been advocated, such as cannulated Smith-Petersen nails, wire, pins, screws, screw-bolts, lag-screws and so on Moore has recently reported a number of cases in which he successfully applied his method of placing three stiff wires at different angles in such a manner that the head was held firmly to the neck of the bone His method has the advantage that there is very little exposure of tissue and local anesthesia is used

Internal fixation is not a simple procedure, although it would seem that it should be, after one has accurately reduced a fracture of the neck of the femur, to fix it with a nail, pin or screw Certain anatomic peculiarities of the neck of the femur explain why this is not easy The neck of the femur is not more than one inch (2 5 cm) in diameter , it is placed at an angle with the shaft of approximately 130° and in addition it has an anteversion angle of about 15° These facts, along with a situation wherein the fracture is deeply covered with fat and muscle, and the proximal fragment cannot be grasped, renders the task of nailing a fracture of the neck of the femur anything but simple

Methods Employed—It goes without saying that the first essential of any procedure is proper reduction of the fracture (Fig 1A) To be certain that this is accomplished, anteroposterior roentgenographic views (Fig 1B) are not sufficient, but lateral roentgenograms must be made also Lateral views (Figs 2a and b) are not always easily obtained but the operation should not be attempted unless the surgeon has this information at his command Taking roentgenograms of fractured hips is not a daily routine in the average hospital, therefore, technicians should practice on normal individuals and perfect themselves in the technic of taking lateral views, so that, when the surgeon is depending so absolutely on the roentgenograms for the success of his operation, they will not be found inexperienced and unprepared

One method may be called the "open method," in which the fracture is reduced after the hip joint has been laid wide open Reduction is ac-

complished under visual control, and the nail, or whatever fixation is used, may also be placed more or less under visual control Even so, the accuracy of the reduction and the placing of the nail, pins, or screw always should be

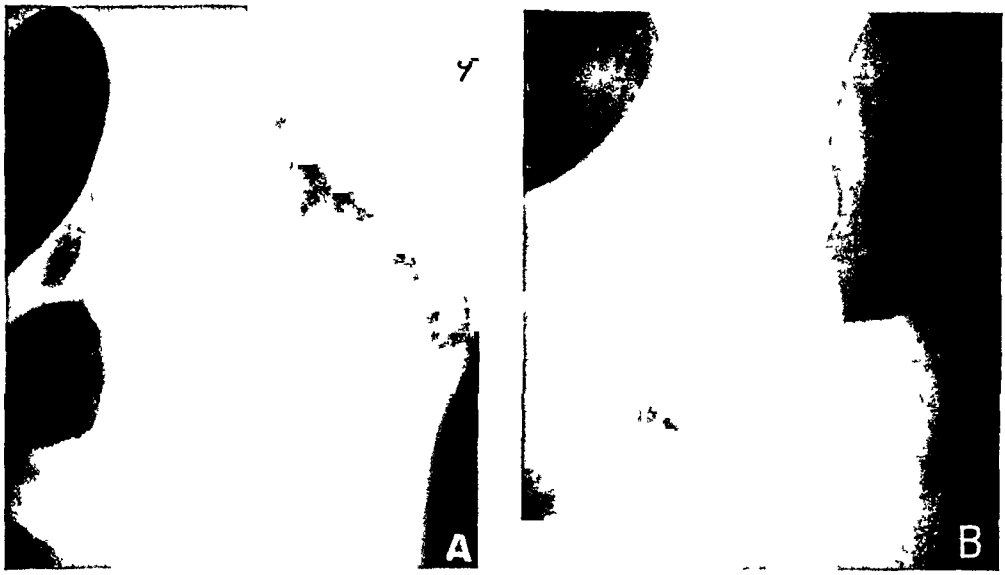


FIG 1.—(A) Anteroposterior view before reduction (B) Anteroposterior view after reduction Note favorable valgoid position of head on neck

verified by roentgenographic examination before the patient leaves the operating table Such an operation is a major procedure, entailing a large incision and considerable dissection, with the attendant risk of shock and infection

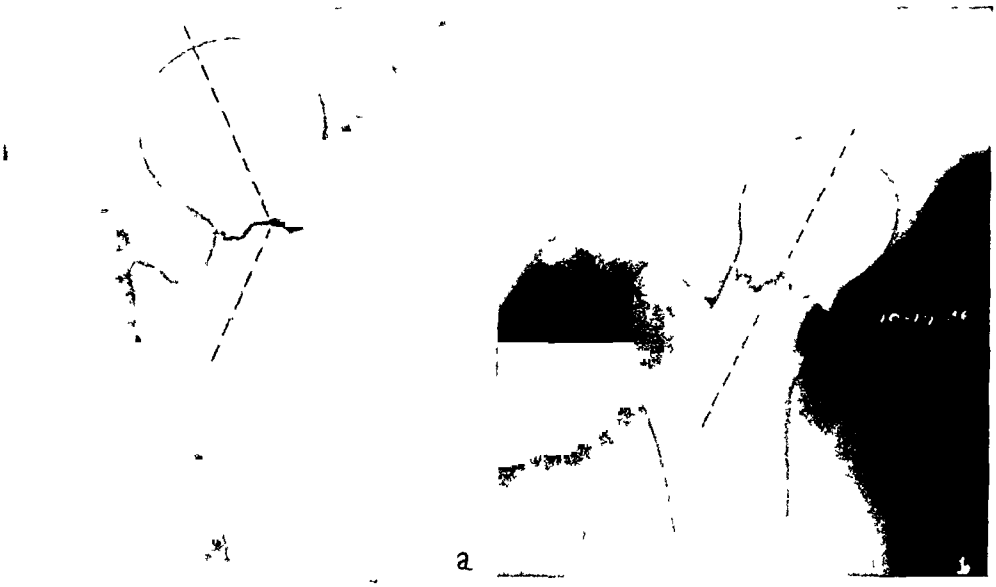


FIG 2.—(a) Lateral view before reduction (b) Lateral view after reduction

However, this method has been practically abandoned and has been replaced by the second method, often erroneously called the "blind" method of insertion of a nail or screw With proper care as to details such as roent-

genograms at the operating table, calculations as to the angle and depth of insertion of the nail or pins or screw, it is anything but blind in the sense of being uncontrolled

Guiding Wire for Cannulate Nail or Lag-screw—Many instruments have been devised to aid in ascertaining the proper angle for insertion of the nail or screw I have used a number of these instruments but none is sufficiently satisfactory that I am willing to drive the nail in or insert the screw without additional control It is extremely important that insertion of the nail or screw be accurate for if it has to be withdrawn and inserted again, much damage may be done to the neck and head of the femur, as has been mentioned, the neck is really quite narrow The placing of a guiding wire under fluoroscopic control or by means of a series of roentgenograms, to insure accuracy, solves the problem

The idea of a cannulated nail, to be inserted over a thin guiding wire was developed independently in three places of which I know Johansson,[4] of Gothenburg, Sweden, was the first to use such a nail King,[5] of Melbourne, Australia, did the same thing as did I[1] at The Mayo Clinic and it has doubtless been done elsewhere also Definite information as to the position of the guiding wire enables the surgeon to be certain that the line and angle at which he inserts the cannulated nail or screw is accurate, for neither can go wrong on the guiding wire The length of nail to be used, and how far it is to be inserted, can be determined by measuring the portion of wire that protrudes from the trochanter and subtracting this from the known total length of the wire

Selection of Cases—It must be emphasized that if immediate operation for fracture of the hip is performed routinely on a fracture service, an unnecessarily high mortality will result A number of these patients are definitely senile, have advanced arteriosclerosis and, therefore, present poor surgical risks On admittance of patients to the hospital a thorough medical examination should be insisted upon They should be made as comfortable as possible, to this end, as has been stated, extension is used either with or without a Thomas splint If, after ten days, the patients are in good condition, the relatives may be assured that treatment to secure bony union probably will not entail a mortality risk of more than 3 or 4 per cent, whereas, if such treatment is routinely instituted in cases of fracture of the hip almost as soon as the diagnosis is made, the mortality risk will be nearer 20 per cent This delay in starting treatment is not necessary if patients are young and robust It may be that time and experience will prove that immediate internal fixation, accomplished skillfully and quickly, under spinal or local anesthesia even if the patient is an elderly, weak individual, will save some of them, thus far, however, there is no evidence to that effect On the contrary, in several localities, where every patient was operated upon at once, regardless of age and condition, the mortality was truly appalling and many deaths that would have occurred anyway were accordingly charged to surgical operation, much to its discredit The delay

makes no difference in the end-result insofar as obtaining union is concerned, therefore, there is no need for hurry

The type of fracture has a definite bearing on what type of internal fixation should be used Generally speaking, trochanteric fractures and many of the basilar neck fractures are not suited to the use of either the Smith-Petersen nail or the lag-screw The amount of bone left in the distal fragment is too small to give adequate fixation to that portion of the nail which lies within it If the devices just referred to are used under such conditions, full abduction must be maintained In my experience, the technic of Moore, in which three or four small wires are used, is preferable in these types of cases Quite often, also, trochanteric fractures are comminuted

Reduction of the Fracture—The fracture should be accurately reduced

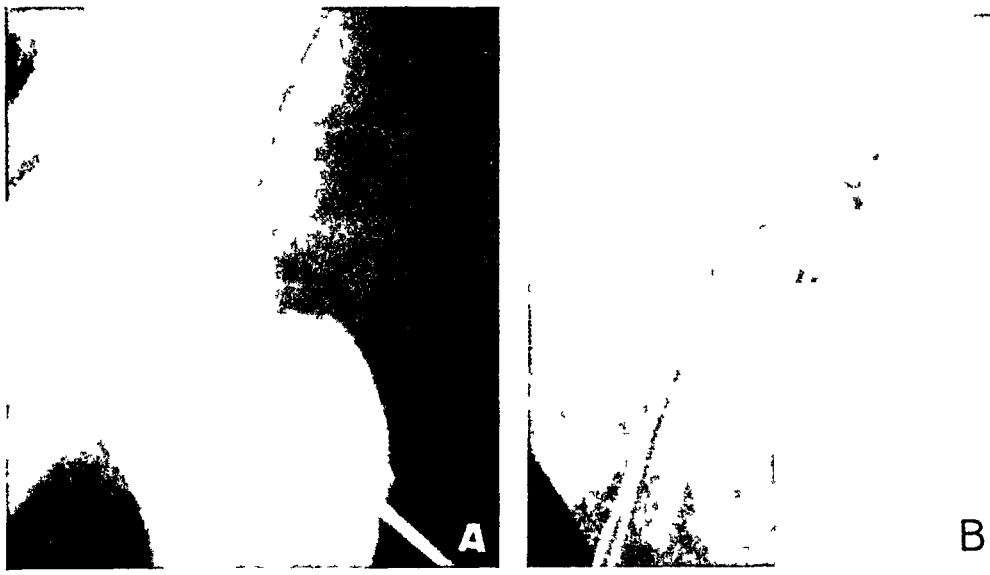


FIG 3—(A) Locating wire with guiding wire inserted Anteroposterior view (B) Locating wire with guiding wire inserted advantageously into middle of head

Sometimes this is accomplished merely by traction during the period of waiting If so, manipulation need not be carried out and some surgeons insert the device for internal fixation with the patient in bed, most surgeons, however, prefer the safety of the operating room If the fracture is not reduced under traction, manipulative reduction, such as has been described by Leadbetter,[6] should be carried out and the reduction proved by anteroposterior and lateral roentgenograms

Technic of Operation—A convenient cutaneous incision is a diagonal one, running from the vicinity of, and slightly posterior to, the anterior superior iliac spine, downward and backward, just below the trochanter This makes possible satisfactory exposure of the trochanter and of a portion of the shaft just below it After careful calculation, based on study of anteroposterior and lateral roentgenograms, a stiff pointed wire is inserted under hand control and lateral and anteroposterior roentgenograms are taken

Then, if direction and position are correct, the guiding wire is directed through the lower portion of the trochanter into the neck, into the head, and inserted to a depth of approximately 10 cm Roentgenograms are taken again, in anteroposterior (Fig 3A) and lateral directions (Fig 3B), to determine whether the wire is deep enough in the head and near enough to the middle of the neck and head to warrant inserting the nail or screw If conditions are satisfactory it is an advantage, after the length of nail that is necessary has been calculated in the manner described, to insert the wire a short distance into the acetabulum, thus helping to steady the head as the nail or screw is inserted Then the cannulated Smith-Petersen nail or cannulated lag-screw is threaded over the wire and inserted to the proper depth It is well to verify this final step by another anteroposterior roentgenogram (Fig 4) The original Smith-Petersen nail has three narrow flanges that are sharp and can be driven in fairly easily When the nail is made cannulate, the center, where the flanges meet and through which the guiding wire glides, is somewhat thicker than when this nail is not cannulate This means that more bone must be displaced and pushed aside as the nail is driven in, requiring more force in the hammering By slipping a small cannulated reamer over the wire a small channel can be prepared in the bone and insertion of the nail or screw can be rendered easier

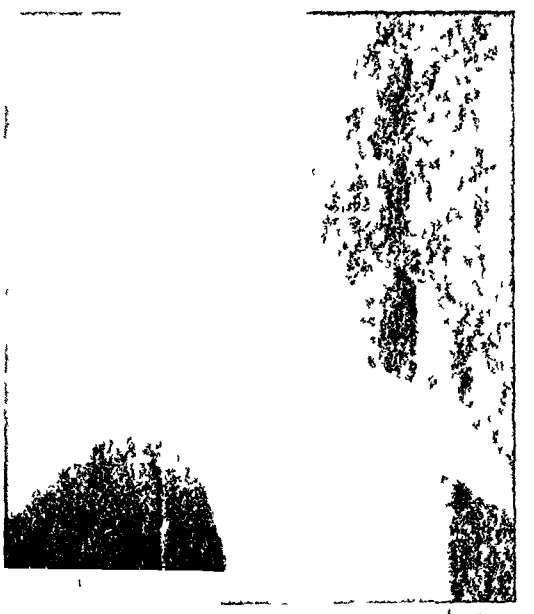


Fig 4.—Lag screw of duralumin inserted on guide wire by aid of locking bar and placing sleeve

A point in technic which must be emphasized is the necessity of having the nail deep enough in the proximal fragment (head) so that it gets a good hold, and valgus position of this fragment should be obtained if possible If the lag-screw is used, care must be taken to see that all of the large threads on the end of the lag-screw are well in the head If one thread is left in the neck and two threads in the head manifestly one of the chief advantages of a lag-screw will be lost namely, its ability to approximate the head and neck

After the foregoing procedures have been completed, the wound is closed and a single plaster spica applied This spica is worn for about two weeks

Lag-screw.—A lag-screw is similar to the screw-bolt described by Henry and has long been used by mechanics to approximate surfaces where it is impossible to use a bolt

The lag-screw,[2, 7] modeled to our requirements by Mr George Little,

chief of the instrument shop at the Clinic, can best be described by referring to the drawing which shows the assemblage in cross-section and end view (Fig 5) All parts of the assemblage are cannulated by a No 47 drill The lag-screw has three large threads, notched to prevent turning of the screw when the placing sleeve is unscrewed A Kirschner wire is inserted as a guide (Fig 6a) Previous to insertion of the lag-screw a cannulated reamer is run down over the wire so that the screw will not have too much bone through which to cut (Fig 6b) The lag-screw is inserted over the guiding wire by aid of the placing sleeve locked into position by means of a locking bar (Fig 6c) All the large threads must be in the head of the femur and roentgenograms are taken to be certain that the lag-screw is placed at sufficient depth Next, the locking bar is loosened, removed and

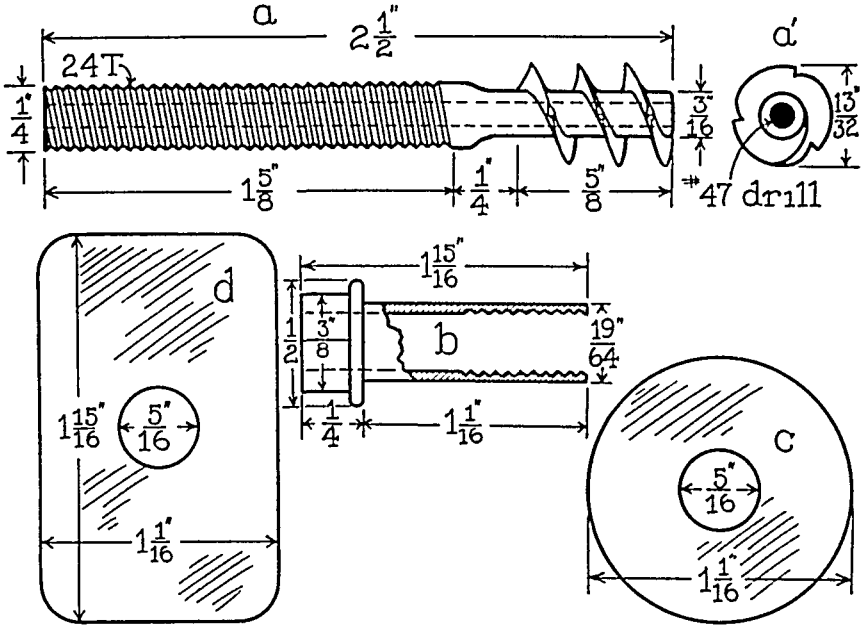


FIG 5.—Lag screw assemblage with measurements The washer to be used beneath the sleeve nut should be of the same material as the lag screw (a and a') Lag screw (b) Telescoping sleeve nut (c) Round washer (d) Larger washer that can be molded

the placing sleeve is unscrewed and withdrawn This leaves the lag-screw entirely buried (Fig 6d) but the guiding wire permits slipping the telescoping sleeve nut (Fig 6d), on which is a washer, down to the distal end of the lag-screw which is threaded to receive it The sleeve nut is tightened by aid of a socket wrench until the washer impinges on the trochanter and is molded around it and the sleeve nut further tightened This draws the fragments together tightly (Fig 6e) The guiding wire is then removed, the wound closed, and a plaster spica applied

Monel metal is thought to be a satisfactory material from which to construct the lag-screw, telescoping sleeve nut and washer, but the last word has not been said on this question All must be made of the same metal or an electrolytic, irritative reaction will be set up and cause a collection of

fluid that on culture is found to be sterile There may be no evidence of fluid until six or even ten weeks after insertion of the metal Once present, it persists until the metal is removed If the effusion is excessive, repeated aspirations may be necessary I do not know whether the slight movement that occurs between the female portion, that is, the telescoping sleeve nut, and the male portion, that is, the distal, threaded end of the lag-screw, is sufficient to produce the electrolytic reaction Dentists have long been bothered by electrolytic reactions after the filling and capping of teeth In those cases in our series in which this sterile fluid did collect, no untoward effect was noted insofar as the end-result was concerned Lag-screws made of duralumin have caused the least reaction and we intend to use them in the future They should not be left in place (Fig 7) longer than six months Those removed (Fig 7) have shown distinct evidence of erosion due to tissue reaction and it is conceivable that this may easily become so extensive that the lag-screw would be weakened, the threads destroyed and removal made difficult

We have not enough cases in which the lag-screw has been used to justify our offering any comparison as to the relative merits of it and of

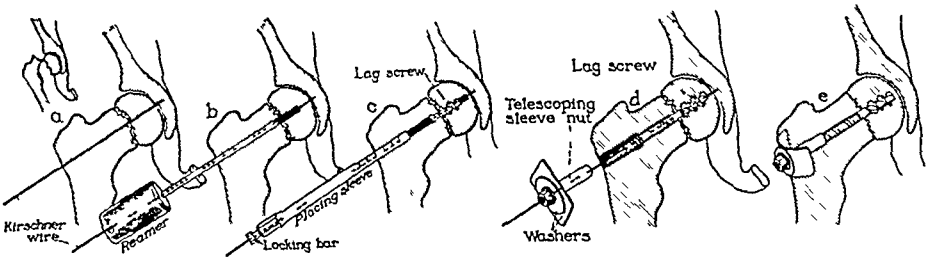


Fig 6.—(a) Kirschner guide wire in situ (b) Reamer introduced over the wire to make a channel and prevent binding of the screw on insertion (c) Lag screw being inserted by aid of placing sleeve and locking bar (d) Lag screw in position, channel in trochanter enlarged to facilitate insertion of sleeve nut (e) Sleeve nut tightened The large threads are in the head of the femur only The Kirschner guide wire has been removed

the Smith-Petersen nail They are both forms of metal, internal fixation The lag-screw has the advantage of approximating the femoral head and neck and can easily be made to fit the individual patient by merely screwing down the telescoping sleeve nut Its use entails a more complicated procedure than use of the nail and time alone will show whether its apparent and theoretic advantages are borne out in actual practice

Postoperative Care.—Motion of the hip and knee may be started safely after 14 days This is best done by aid of a system of overhead suspension, with sling, ropes and pulleys The patient, by pulling on the rope, flexes the knee, and so the hip, but he must not be permitted to over-do Flexion of the hip by this passive method to an angle of 45° to 60° is ample It must be remembered that there is nothing in the internal fixation that will cause bony union to develop more rapidly It is estimated that even under the best of conditions bony union never occurs in less than 90 days (Fig 8A) Therefore, weight-bearing in less than that period should not be permitted and a

safe rule is to insist that full weight-bearing be delayed until six months have elapsed (Fig 8A) It was at first hoped that the size and strength of the Smith-Petersen nail would render possible much earlier weight-bearing but Smith-Petersen himself now warns against this Internal fixation of these fractures entirely changes the picture of convalescence Patients are out of bed and soon are getting about on crutches and their whole view of life is much more cheerful than otherwise

Discussion of Cases in Which Operation Has Been Performed —This report is based on 14 cases, in 11 of which the patients were women and in three, men In all, more than one year has elapsed since the operation and the condition of the patient is known The ages of the patients were as follows One was between 20 and 30 years of age, one, between 40 and 50 two, between 50 and 60, five, between 60 and 70, four, between 70 and 80, and one, more than 80



Fig 7—Lag screw assemblage ten weeks after insertion

Five patients were operated upon more than three years ago, three, more than two years ago, three, more than 18 months ago and three more than one year ago There were no deaths attributable to the operation although two patients have died since convalescence One of these was a woman, more than 80 years of age, who lived for 18 months after insertion of a Smith-Petersen nail and walked comfortably although feebly, she died of the changes of senility The nail was not removed The other of these two patients was 70 years of age and died of a heart attack 16 months after operation She likewise had solid bony union and the nail was never removed Both of the two patients who died were of the group of five who were operated upon more than three years ago The other three patients in this group obtained bony union but one, now age 70, has definite arthritis, with some shrinking and irregularity in the size and shape of the femoral head The remaining two, both now over 70 years of age, have normal function

Of the three patients who were operated upon more than two years ago, all have excellent results, with normal function One was a woman, age 20, injured while horseback riding, one was age 56 and the other, age 72

Of the three cases in which more than 18 months have elapsed since the operation, one has not done well She was 70 years old when she was operated upon, and 15 years before she had undergone resection of the

stomach for carcinoma We suspected that the fracture of the hip might be attributable to metastasis but it did not appear to be so on careful study, therefore, a Smith-Petersen nail was inserted A late, slightly purulent drainage of low grade followed, the nail was removed three months after insertion The drainage has ceased and now, 21 months afterward, I feel certain that the fracture is united There is poor function, however, the patient is old, frail and weak, and I fear hidden, late metastases, although this cannot be proved Of these three patients, the other two, one 61 and the other 67 years of age, have, to all intents and purposes, normal function and both have bony union

Of the three patients who were operated upon more than one year ago, one, a woman, age 76, was treated by means of a cannulate, large-threaded,

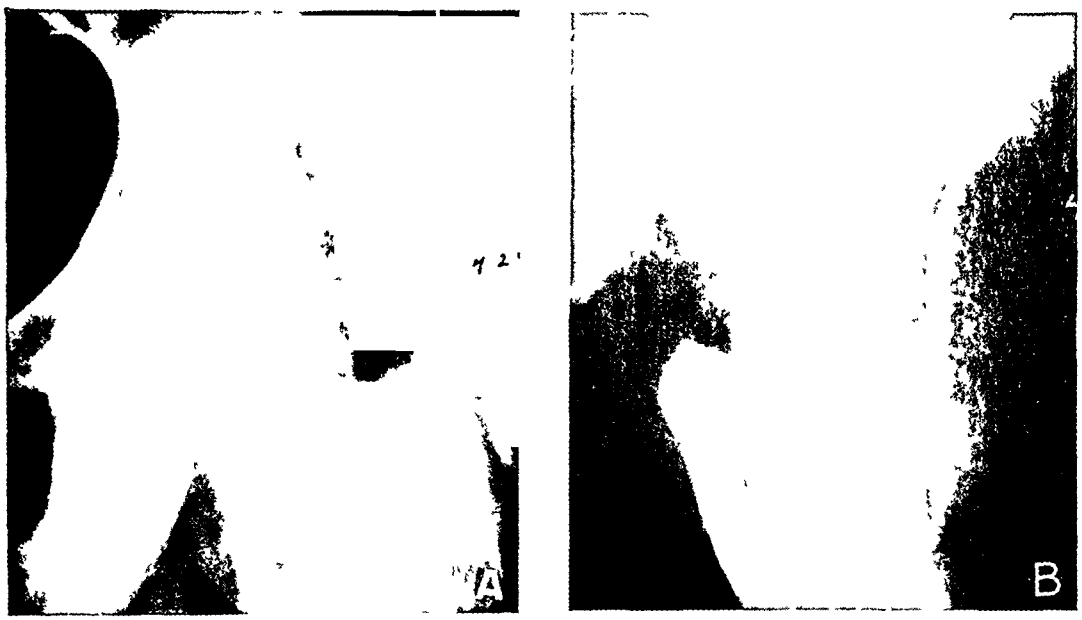


FIG 8.—(A) Lag screw removed Anteroposterior view shows bony union eight months after operation (B) Same patient as is represented in Fig 7 Lateral view eight months after operation

wood screw It did not hold properly, serious drainage of low grade developed six weeks after operation and the screw was removed after six months I would put her case down as a failure although I believe that bony union is present In the two other cases the patients were age 77 and 54, respectively, both have solid bony union with excellent function

SUMMARY.—Of 14 patients subjected to operation more than one year ago, 12, or 86 per cent, obtained really excellent results, that is, they have bony union with excellent function One has union in malposition and she is in poor health, so the result cannot be called good No serious infection occurred, drainage followed late in two cases There were no deaths from the operation and in all cases convalescence was much more satisfactory than has been our experience in treating fractures of the neck of the femur by the conservative method

CONCLUSIONS

Internal fixation is a definite step forward in the handling of fractures of the neck of the femur for it raises appreciably the percentage of unions The next step is to establish its value in the early restoration of function and whether atrophy of the head follows in its wake more often than occurs following conservative treatment

REFERENCES

[1] Henderson, M S Fractures of the Neck of the Femur, Recent and Old, a Report of 631 Cases South Med Jour, 27, 1032–1039, December, 1934

[2] Henderson, M S Discussion Proc Staff Meet Mayo Clinic, 11, 615–618, September 23, 1936

[3] Henry, M O Intracapsular Fractures of Hip, New Device for Lateral Osteo-synthesis Jour Bone and Joint Surg, 16, 168–172, January, 1934

[4] Johansson, Sven On the Operative Treatment of Medial Fractures of the Neck of the Femur Acta Orthopaed Scandin, 3, 362–392, 1932

[5] King, Thomas Recent Intracapsular Fractures of the Neck of the Femur a Critical Consideration of Their Treatment and a Description of a New Technique Med Jour Australia, 1, 5–15, January 6, 1934

[6] Leadbetter, G W A Treatment for Fracture of the Neck of the Femur Jour Bone and Joint Surg, 31, 931–940, October, 1933

[7] Macey, H B Report of the Fracture Service for 1935 Proc Staff Meet Mayo Clinic, 11, 613–614, September 23 1936

[8] Moore, A T Fracture of the Hip Joint Treatment by Extra-articular Fixation with Adjustable Nails Surg, Gynec & Obstet, 64, 420–436, February 15, 1937

[9] Smith-Petersen, M N, Cave, E F, and Vangorder, G W Intracapsular Fractures of the Neck of the Femur, Treatment by Internal Fixation Arch Surg, 23, 715–759 November, 1931

BRIEF COMMUNICATIONS AND CASE REPORTS

A METHOD OF REDUCING LARGE DIAPHRAGMATIC HERNIA FROM ABOVE

HARRY G SLOAN, M D
CLEVELAND, OHIO

THERE has been divergence of opinion over the best surgical approach for the repair of diaphragmatic hernia Some advocate an abdominal incision Others open both the chest and abdomen In the combined approach reduction is made easier by traction from below on the herniated viscera

We agree that parasternal hernias are best approached through the abdomen This type may invade either pleural cavity or both at the same time If the hernia invades both pleural cavities (a difficult preoperative diagnosis) then there is less chance of causing a bilateral pneumathorax in using the abdominal approach, and both sides may be repaired at the same sitting We are suggesting a method by which the reduction of all other hernias can be readily accomplished through the chest wall Any adherence of the herniated viscera to the structures of the thorax can be dealt with under direct vision If the herniated viscus is held too snugly by a tight ring, then the rent in the diaphragm can be enlarged at one end Phrenic nerve damage is to be avoided In case one finds an obstructed gangrenous intestine in the chest cavity, it will then be necessary to open the abdomen so as to bring the clamped-off bowel out through the abdominal wound Anastomosis is not practical It is wise to bear in mind the possibility of an acutely obstructed diaphragmatic hernia when the cause of an intestinal obstruction is unexplained Its detection will save opening the abdomen when the better approach may be by way of the chest The history of a severe antecedent trauma to the torso may arouse the suspicion of the correct diagnosis in the examiner's mind Unequal movement of the costal margins on respiration, a displaced cardiac dulness or abnormal auscultatory findings in the thorax will be an indication for taking a scout film of the chest, which will confirm the diagnosis The use of contrast media to accentuate the roentgenologic findings is, at such a time, hardly feasible

Case Report—A male, age 46, was seen in consultation with Dr E R Brooks, April 1, 1936 The patient had been in an automobile wreck six months before, but did not know what struck him, probably it was the steering wheel, as he was driving He was unconscious for several minutes following the accident The right side of his chest and abdomen were lame for the next three weeks Two months ago he started to have abdominal cramps and an increasingly more marked gurgling in his upper abdomen and

Submitted for publication May 15, 1937

FIG 1

FIG 2

FIG 3

FIG 1.—Standing Roentgenogram showing the herniation of hollow viscera into the right chest cavity

FIG 2.—Roentgenogram after administration of barium The cardiac end of the stomach is seen to lie under the left diaphragm The entire body of the stomach is herniated through the right diaphragm The herniated part shows a marked upward angulation The pylorus and duodenal bulb are on the right side under the diaphragm Stomach constricted at the entrance into the chest and at the exit from the hernial opening

FIG 3.—Roentgenologic examination of colon after barium enema showing the extensive herniation of the right side of the transverse colon Exit and entrance of herniated loop are indicated by the points of constriction

right chest Examination of his chest showed no cardiac displacement but the unequal flare of his costal margins on deep breathing plus the gurgling heard over his right chest on auscultation On roentgenologic examination, Dr Eugene Freedman made the fluoroscopic diagnosis of an anterior right-sided diaphragmatic hernia (Figs 1, 2 and 3)

Operation—The stomach was washed out, in order to eliminate regurgitation during the manipulations Anesthesia—Avertin (60 mg per kilo) plus nitrous oxide, without intratracheal catheter The head of the table was raised 20 degrees and the patient placed on his left side, his body rotated in the long axis 30 degrees, so that his right chest was uppermost The right arm was raised above his head Block of the seventh, eighth and ninth intercostal spaces, posteriorly, with 10 cc of 1 per cent novocain solution in each

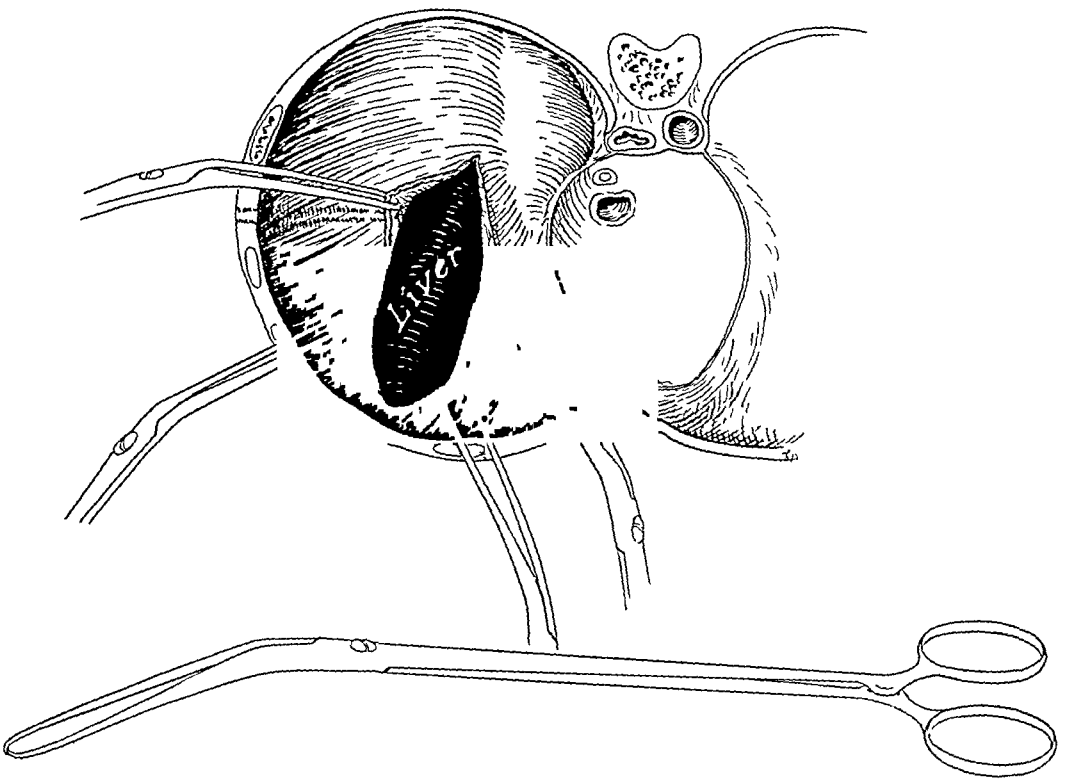


FIG 4—Upward traction on the edges of the rent by Lower's hooks as an aid in reducing diaphragmatic hernia via the chest approach

interspace Incision 30 cm long in the eighth interspace from the posterior axillary line to the midline in front Intercostal muscles divided and the chest opened widely with a rib spreader Due to the presence in the chest of the abdominal viscera, there was little change in respiration with the chest open One saw the retracted lung lying in the upper medial area of the chest

In the lower chest we found small intestine, colon, stomach and most of the right lobe of the liver The liver had been rotated on its transverse axis and, as one looked into the chest from the front, the lower liver surface presented, with the fundus of the gallbladder pointing up toward the right shoulder The liver had been drawn into the chest, from the notch, to the area on its lateral margin which corresponded to the posterior axillary line on the chest wall

We were able by the sense of touch to hook an index finger beneath the medial edge of the rent in the diaphragm and then catch this edge in front and behind with two Lower angled, bladder hooks In the intervals of relaxation of the diaphragm that followed each respiratory movement, we reduced the hollow viscera into the abdominal cavity This gave enough space in the chest so that we could catch the lateral edge of the rent in the diaphragm with two more bladder hooks The liver was then easily reduced Upward

traction on the bladder hooks helped greatly in the reduction One reduces intestines during a celiotomy in the same manner by vertical traction on the wound edges

Dr W E Lower had adapted these hooks from the ordinary single-toothed cervical volsellum They are made in pairs—right and left angled—the blades of the forceps are bent 30 degrees laterally, just distal to the lock (Fig 4) Their use permits upward traction of the wound edges of the diaphragm without having the handles of the instruments get in the operator's way Their use materially helps in the reduction of the hernial contents in the chest approach They also are helpful in holding the edges of the rent together while the sutures are being laid for the repair



Fig 5 —Appearance of wound ten days after operation

There was no tendency after reduction for the abdominal contents to reenter the chest as the liver acted as a stopper to hold them in their normal position

The tear in the diaphragm was clean cut, 15 cm in length and lay in the axis of seven o'clock—looking from above down Its origin was at the nipple line, starting 2 cm from the attachment of the diaphragm to the chest wall, and extended medially and posteriorly into the central tendon It was closed with silk sutures placed at 5 Mm intervals There was no tension on the suture line Closure of the chest wall with three silver wire sutures which encircled the eighth and ninth ribs Closure of the intercostal muscles with interrupted silk Before pulling tight the last muscle suture we asked the anesthetist to expand the lung by increasing the gas pressure and then aspirated the remaining air left in the pleural cavity by catheter suction Fine silk in the subcutaneous fat, clips in the skin

During the operation the blood pressure remained around 120/90, pulse 76 to 80 In

order to reduce postoperative retching, we gave nothing by mouth for two days following operation Continuous intravenous drip was supplied by a cannula in the internal saphenous vein at the ankle for 48 hours Convalescence was uneventful (Fig 5) Discharge April 15, 1936

Fluoroscopic examination and roentgenograms of the stomach and colon, April 14, 1936, showed all the viscera to be back in their normal positions Both diaphragms moved normally under the fluoroscope

Follow-up—September 14, 1936 He had gained ten pounds in weight, and was eating everything without complaint Both diaphragms move normally

ACUTE INFLAMMATORY JEJUNITIS WITH INTESTINAL OBSTRUCTION *

PERCY KLINGENSTEIN, M D
NEW YORK, N Y

Case Report—The patient, a male, age 21, presented himself for admission to the Mount Sinai Hospital, with a history of acute abdominal pain and vomiting, which had begun seven hours previously For a period of two months preceding admission the patient had had peri-umbilical discomfort He appeared acutely ill, and presented resistance, tenderness, and rebound tenderness in the right lower quadrant of the abdomen A leukocytosis was present, and a diagnosis of an acute appendicitis was made He was operated upon (Garlock) through a McBurney incision The appendix was found to be bound down by a few edematous adhesions It, however, aside from slight injection, did not show gross evidences of an acute process Search for a Meckel's diverticulum or terminal ileitis was negative The abdomen was closed in layers, and an uneventful convalescence ensued

About a month later the patient was readmitted because of persistent pain and diarrhea, the stools numbering from two to five a day and in some, dark blood was noted There was no pus or mucus The pain was quite severe and was frequently accompanied by a desire to defecate The physical examination, including sigmoidoscopy, was essentially negative Barium enema was negative In view of the negative findings it was felt that the patient was suffering from a functional mucous colitis and was discharged to receive country convalescent care and then be admitted to the Mental Health Clinic About a month later he was again readmitted with a history of recurring generalized abdominal pains which seemed to be more marked after taking food, although they bore no definite relationship to meals They seemed to be most marked in the left lower quadrant of the abdomen Bowel movements averaged two a day

Physical Examination revealed a thin, asthenic, chronically ill young man with general, moderate abdominal distention There was slight tenderness throughout the abdomen, most marked in the left lower quadrant No masses could be palpated During a 48 hour period of observation the patient continued to have increasingly severe cramps and at this time visible peristalsis was noted in the left lower quadrant He vomited once A tender mass could be palpated per rectum

Operation—Through a four inch left lower rectus incision the peritoneum and omentum were found to be deeply injected Loops of presenting small intestine were markedly dilated Palpation revealed a sausage shaped mass occupying an area in the small intestine about one foot in length, located in the distal jejunum Its proximal end was hard and infiltrated, the distal end was edematous and covered by a shaggy peritoneal exudate The proximal intestine was hugely dilated, the distal collapsed A lateral

* Presented before the New York Surgical Society, November 25, 1936 Submitted for publication March 5, 1937

anastomosis was made between the afferent and efferent loops The anastomosis was made sufficiently distant from the tumor mass to permit of subsequent resection without disturbing the anastomosis, if this should be found to be necessary The wound was closed in layers without drainage, and an uneventful postoperative convalescence ensued

Subsequent Course—The patient has been seen on numerous occasions, and until recently has appeared to be in the best of health For the past four or five months, however, there has been some abdominal discomfort, although he has maintained his weight and his bowels have been moving normally Recent roentgenologic examination of the gastro-intestinal tract reveals several areas of stenosis in the small bowel producing dilatation proximal to them Some of these loops are markedly dilated and are situated in both the jejunum and ileum

COLECTOMY FOR CHRONIC ILEOCOLITIS

POSTOPERATIVE INTESTINAL OBSTRUCTION PERFORATION OF ILEUM BY ENTEROSTOMY TUBE SUBPHRENIC ABSCESS RECOVERY

Case Report—The patient, a male, age 18 was first admitted to the Mount Sinai Hospital in August, 1935, complaining of abdominal cramps which had been present for six weeks, accompanied by some temperature and profuse sweats There had occurred a similar episode three months before admission He had had three to four loose brown stools daily during the period of his present complaint No blood, mucus or pus had been noticed in the evacuations There was an appreciable loss in weight The abdominal pain was for the most part confined to the right lower quadrant

Physical Examination revealed a thin undernourished chronically ill young man Except for the abdomen, where moderate tenderness in the right lower quadrant could be elicited and a thickened area of intestine could be palpated, the physical examination was negative The stools consistently showed a four plus guaiac Sigmoidoscopy revealed no abnormality Gastro-intestinal roentgenologic study showed an irregular stenosis of the terminal ileum with dilatation proximally In addition, the colon from the cecum to the region of the splenic flexure showed loss of haustrations and marked disturbance in the mucosal pattern, indicative of an ulcerating lesion Barium enema revealed an irregular stenosing lesion of the entire proximal half of the large bowel

Operation—Under general anesthesia, the abdomen was opened through a left, midrectus incision The terminal ileum, cecum and ascending colon were found thickened and edematous The sigmoid appeared normal The terminal ileum was divided one foot proximal to the ileocecal angle and a side-to-side ileosigmoidostomy was performed A wound infection developed, but otherwise the convalescence was uneventful

The patient was readmitted one and one-half months later for colectomy During this time he had gained some weight, but his stools still contained blood and he still continued to have abdominal cramps, although on the whole his condition had improved considerably

Operation—Under general anesthesia, the scar resulting from the previous operation was excised, adhesions divided and separated, and the previously effected ileosigmoidostomy identified The terminal ileum, ascending, transverse and splenic flexures were resected after separating the omentum The resection extended into the uppermost portion of the descending colon where the bowel appeared healthy Retroperitoneal spaces were peritonealized The wound was closed in layers without drainage except for rubber tissue drains placed superficially at either angle

Pathologic Examination—*Gross*—The specimen (Fig 1) consisted of the terminal 18 cm of ileum, appendix, and 45 cm of ascending, transverse, and splenic flexures of the

colon The mucosa of the proximal portion of the resected ileum was soft, succulent and presented innumerable pinhead-size, delicate pink excrescences The more distal 5 cm of the resected ileum was smooth, its mucosal folds completely obscured, the mucosa thickened, and there were many shallow, punched out mucosal defects varying in size from a pinhead to ½ cm in diameter The bases of the ulcerations were finely irregular, hemorrhagically discolored The mucosa about these ulcerated areas was pearl gray with here and there a hemorrhagic, punctate zone The wall of the ascending colon was slightly thickened, firmer than is usual, the mucosa irregularly mottled, dark red, pink and gray The basic architecture of the colonic mucosa was completely obliterated There were noted in the proximal portion of the ascending colon, and



FIG 1 —Gross specimen of resected terminal ileum, ascending, transverse and splenic flexures of colon for ileocolitis

more particularly in the cecal area, several shallow, punched out ulcers with hemorrhagic bases There were many slightly pouting, longitudinal folds, soft in consistency, varying in breadth from ½ to 1½ cm, doughy in consistency and separated, one from the other, by hemorrhagically discolored, craggy, slightly depressed, linear zones Toward the terminal portion of the specimen it was noted that the pouting linear strands described before represented portions of the normal colonic mucosa which was present at the terminal portion of the resected specimen

The appendix measured 5 cm in length and had been previously opened, its mucosa was slightly thickened, succulent, and in its basal portion presented two pinhead-sized punched out, superficially ulcerated areas, the bases of which were pearl gray The serosal aspect of the specimen presented dull gray, exceedingly fine mammillations

There were numerous pericolonic lymph nodes, oval in shape, varying from ½ to 2 cm in length and ½ to 1 cm in breadth They were rather soft in consistency, their sectioned surfaces moist, their peripheral portion pearl gray, while the central zone was light red

Microscopic Diagnosis—Chronic ulcerative colitis involving the terminal ileum

Postoperative Course—The patient appeared to be doing very well following this procedure until four days after operation, when he presented classical signs of an intestinal obstruction, which was confirmed by a scout roentgenogram of the abdomen which showed distended small bowel with fluid levels Celiotomy was performed five days after the colectomy through a right midrectus incision Numerous distended coils of the small intestine were encountered bound down by recent adhesions There was a large quantity of free fluid in the abdomen The intestines were traced down to the region of the ileosigmoidostomy and it seemed that some loops ran under the mesentery of the ileum used in making this anastomosis It was deemed inadvisable to disturb this mesentery for fear of compromising the blood supply An enterostomy, using a No 26 French catheter, according to the method of Witzel, was effected in the most distal, distended loop The tube was brought out through the lower angle of the incision Following this procedure the patient did well, the enterostomy functioned excellently, and the patient appeared to be well on the road to recovery, with normal temperature and pulse five days after the second operation On the sixth day there was a repetition of the entire clinical picture but this time with a rise in temperature, cramps and abdominal tenderness The enterostomy stopped draining and was irrigated *a number of times without success, fluid being readily introduced but with no return* The patient now appeared extremely ill Roentgenologic examination again supported the diagnosis of an intestinal obstruction, and one week after the previous operation, an incision was made between the two existing scars The abdominal exploration revealed a diffusing fibrino purulent peritonitis with pus and fibrin binding down loops of gut everywhere, particularly in the upper quadrants In separating the loops of intestine, a large abscess cavity was encountered in which the proximal two inches of the enterostomy tube were seen emerging through a free perforation in the ileum The tube was withdrawn and the perforation repaired The abdomen was closed without drainage Culture of the pus revealed *B coli*, enterococci and *Staphylococci aureus* Following this operation patient was critically ill for a long while, and required a number of transfusions The wound became severely infected and had to be widely opened A large quantity of pus was discharged through the upper angle of the incision It seemed to come from an intra-abdominal collection and was traced to the subphrenic region, being visualized by an injection of lipiodol A counter incision, for more dependent drainage, was deemed advisable, which was accomplished by excising the tenth rib, in the postaxillary line, and suturing the pleura to the diaphragm A small rent in the pleura resulted in a pneumathorax Subsequently, with a probe in the abdominal sinus, the subphrenic abscess was incised Following this the patient made a gradual but prolonged convalescence, being discharged well, approximately three months after the colectomy

DISCUSSION—DR HENRY W CAVE (New York) discussed the question of colectomy in reference to chronic ileocolitis In the last eight months he had performed three colectomies for chronic ulcerative colitis, and emphasized what he considered very important points

(1) The importance of three preoperative preparations of these patients (a) Low residue diet (b) Intravenous fluids (c) Fluid diet, 24 to 48 hours preceding the operation, and also pills containing lead and opium for 72 hours prior to the operation, as was suggested by Mont Reid in patients suffering with tumors of the large bowel

(2) Careful selection of cases where colectomy is indicated Recently he had seen a patient who had chronic ulcerative colitis, and upon whom he expected to effect a terminal ileostomy and possible colectomy, until it was discovered the patient was allergic to pork and milk He was taken off these two foods for four months, and has shown a remarkable recovery since

(3) A more thorough side-track of the fecal current can be accomplished by performing an end-to-side ileocolostomy The Rankin clamp and the Furness clamp are excellent in accomplishing an end-to-side anastomosis In the great majority of cases of the chronic ulcerative type, such as Doctor Klingenstein cited, it is preferable to effect a permanent terminal ileostomy, and then, if the colectomy is necessary, he has used a long, left paramedian incision, through which it is easier to sever the splenocolic ligament Transfusion is advocated at the time of the first stage, as well as immediately following the second or third stage procedures In patients where the ulceration involves the rectum, rubber-guarded clamps are preferable to crushing clamps of any kind, because with an unguarded clamp there is great danger of cutting into the thin friable wall of the bowel with resultant soiling

Dr Ralph Colp (New York) recalled, relative to Doctor Cave's mention of the fact that the divided sigmoid is rather difficult to close, especially in cases of ulcerative colitis in which the rectum is not particularly involved, that, in 1913, von Beck reported an operation for ulcerative colitis, in which he divided the ileum near the ileocecal junction, and the colon at the sigmoid The terminal ileum was closed and the proximal loop of colon was brought out as a colostomy, thus isolating the colon He then recommended the anastomosis of the proximal ileum to the distal segment of the sigmoid by end-to-end suture Doctor Colp said the teaching in the past had been that intraperitoneal anastomoses are rather dangerous and should be avoided whenever possible In a recent case, however, he undertook a procedure similar to the von Beck operation, but with modifications He divided the ileum and brought out the proximal colon as a colostomy, thus isolating the colon He then brought the proximal ileum out through a left rectus incision as an ileostomy, and the distal portion of the sigmoid out as a sigmoidostomy, approximating the intraperitoneal portion of both loops by interrupted serosal sutures The sigmoid and rectum are put at rest for a desired period, and, if multiple polypi are present, a sigmoidoscope may be introduced through the rectum or through the sigmoidostomy, and any polypi which may be present may be fulgurated At some future time, provided the general condition of the patient is satisfactory, the spur between the ileum and sigmoid may be crushed, and an extraperitoneal closure effected In that way the danger of intraperitoneal leakage is avoided The isolated colon may then be removed, if necessary.

CHRONIC INFLAMMATORY TUMOR OF THE MESENTERY

Case Report—The patient, a male, age 50, was first seen by Dr Maurice Rashbaum, who identified a large, lobulated, movable abdominal mass during the course of a routine physical examination The patient at that time was ignorant of its existence and it had given rise to no abdominal symptoms He was referred to the Diagnostic Clinic of the Mount Sinai Hospital where complete roentgenologic studies of the gastrointestinal tract were made, but no definite diagnosis was arrived at There had been some recent weight loss There was no diarrhea, cramps or constipation

Physical Examination except for the abdomen was entirely negative In the right lower quadrant of the abdomen there was a hard nodular mass, nontender and freely movable In spite of the negative roentgenologic examination, on account of the firmness and nodularity of the mass, a preoperative diagnosis of carcinoma, possibly in a mobile cecum or in a loop of small intestine, was made

Operation through a five inch, right, midrectus, muscle-splitting incision disclosed the mass previously noted occupying the root of the mesentery of the terminal ileum It was the size of a small orange, hard, nodular, with local lymph node involvement The intestines were agglutinated to it and in one area were compressed In view of the fact that the nature of the lesion could not be decided upon and that it was compressing the lumen of the bowel, a resection was performed This necessitated a wide removal of the terminal ileum The resection reached the most distal portion of the ileum so that an end-to-end anastomosis was impractical A side-to-side ileotransverse colostomy was, therefore, accomplished, and an ileostomy of the Witzel type was added in the ileum proximal to the anastomosis The tube was brought out through the lower angle of the incision The wound was closed in layers

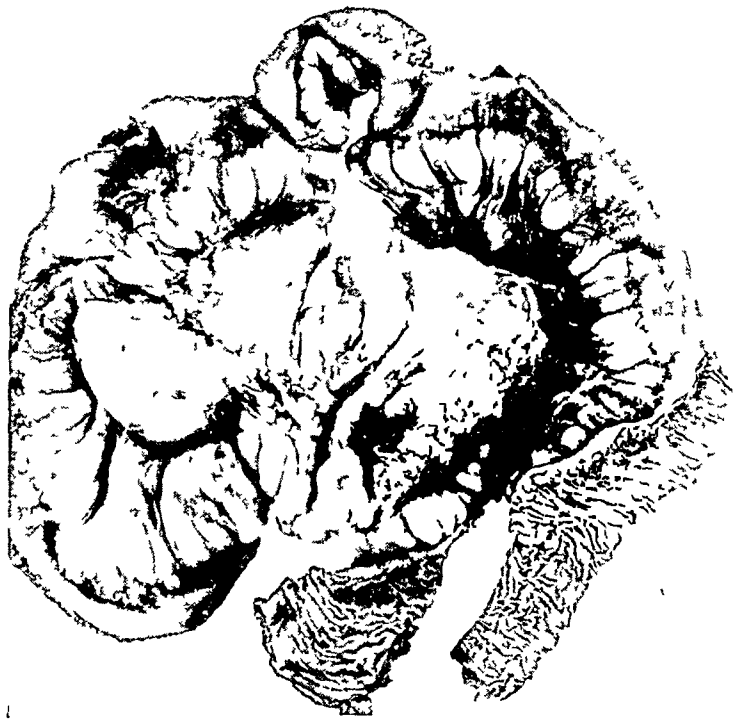


FIG 1 —Gross specimen of resected ileum with large inflammatory tumor of the mesentery

Pathologic Examination —Gross —The specimen (Fig 1) consisted of 46 inches of intestine with its mesentery A large mass occupied the root of the mesentery The mass measured about 8 cm in diameter and was globular It was firm, well defined, and on section revealed normal fat tissue traversed by numerous interlacing dense white strands of fibrous tissue, and was hemorrhagic in places Normal vessels, with unconstricted lumina, were seen coursing through the mass In its periphery a few small fleshy nodes of lymphoid tissue were noted The mesentery to the right and left of this mass was markedly shortened by adhesions, this folded, thickened mesentery was firmly adherent to one face of the mass The mesentery of the central portion of resected bowel approximated the normal length and presented large hemorrhagic areas This fore-shortened mesentery at each end of the resected ileum converted the entire length of bowel into a large horseshoe shaped loop, the bowel itself, as it surrounded the tumor, was thrown into numerous coils The serosal surface of the ileum was

hemorrhagic The opened ileum revealed a perfectly intact mucosa No fistulous tracts were demonstrable

Microscopic Diagnosis—Fibromatous, chronic inflammatory mesenteric tumor

Postoperative Course—The ileostomy tube drained well almost immediately after operation It was clamped off after a period of ten days, following which patient's bowels functioned normally The wound healed by primary union except for a small amount of suppuration at the upper angle where a dam had been inserted at the time of operation Patient was discharged well, 24 days after operation

OBSTRUCTION DUE TO APPENDICES EPIPLOICAE

CARL BAUMEISTER, M D,
COUNCIL BLUFFS, IOWA
C W HARGENS, M D AND C F MORSMAN, M D
HOT SPRINGS, S DAK

REPORTED cases of obstruction of the intestine by means of constriction by two appendices epiploicae becoming adherent across its antemesenteric surface are rare In 1924, Klingenstein[1] reviewed all of the known cases There had been but three instances of this complication recorded In 1933, Patterson[4] reported that there had been but two other cases occurring in the intervening years In 1933, McIver[6] mentioned that the appendices epiploicae may also act as an obstructive band by becoming attached through inflammatory processes He added an additional case There are, therefore, only five reported cases of intestinal obstruction due to adherent appendices epiploicae To this list we wish to add a sixth instance

Case Report—J K, a very obese male, age 62, entered the Sisters Hospital at Hot Springs, South Dakota, March 13, 1937, complaining that he had had no bowel movement since March 9 Four days before he came under our care, his abdomen had begun to become distended, which was accompanied by generalized abdominal pains, and he had vomited twice on the day of onset, since which time he had only been able to pass a small amount of flatus and a little stool which had the appearance of soap water The abdomen had become swollen to tremendous proportions He had been becoming increasingly constipated during the preceding four months, and had had, occasionally, bright red blood in his stool during that time He had lost eight pounds, in weight in the past few months He had never had a hernia, but had had an appendicectomy 11 years ago His appetite had always been inordinate

Examination—Showed four plus distension of the abdomen, and the right rectus appendicectomy scar The bowel sounds were not distinct, and there could be heard an occasional tinkling Rectal examination did not reveal any masses but showed some large internal hemorrhoids Examination was otherwise negative except for the presence of marked obesity Diagnosis Acute mechanical obstruction of the large bowel, probably due to carcinoma of large bowel with probably secondary paralytic ileus (early) (One of us mentioned the possibility of the blood per rectum being due to hemorrhoids and the obstruction to adhesive bands)

Operation—A tremendously distended large and small bowel was disclosed A cecostomy was performed The source of obstruction was not ascertained The patient was only slightly relieved by the operation He developed a complete secondary paralytic ileus, and bubbling râles in his chest There ensued a peripheral vascular failure

Submitted for publication April 22, 1937

with rapid pulse, the heart finally becoming markedly irregular, with a rapid fall in blood pressure before his exitus, March 18

Final Diagnosis—Primary cause of death Acute colonic obstruction with secondary paralytic ileus Secondary or immediate cause of death Acute cardiac failure following a peripheral vascular failure (etiologic factor of this bronchopneumonia and paralytic ileus) Contributory cause Extreme obesity

Autopsy—(Three hours after death) *Peritoneal Cavity* There was no free fluid present The peritoneum, except in the right lower quadrant, was smooth and shiny, there being no engorgement of blood vessels or exudate visible Entering the cecum was a rubber drainage tube Around the cecum was an abscess cavity with walls about 1 cm thick The external surface of the abscess cavity had moist, yellowish, moderately easily separable adhesions between it and the omentum On breaking into the abscess cavity, about 160 cc of greenish yellow, moderately thick, very foul *B coli* pus were found The adhesions surrounding the cavity were principally lateral and inferior The general peritoneal cavity did not appear to be contaminated The liver border was 2 2 cm below the ensiform cartilage and 4 5 cm below the costal margin

Large Intestine—As the large intestine ascended from its junction with the recto-sigmoid there were a number of constrictions across its anterior surface These were caused by adhesions between appendices epiploicae which were located on opposite sides of the gut They were not diverticula The first one of the constrictions between adherent appendices epiploicae was at a point 17 3 cm above the rectosigmoid junction The bowel below this point was not distended Above this point the gut was distended for 18 cm, but was of fairly good color This was followed by another adhesion between two appendices epiploicae Then came a portion of gut 17 7 cm in length which was not distended, at the proximal end of which there was another adhesion between two appendices epiploicae Proximal to this last adhesion between the appendices epiploicae there was distention of the entire gut including the duodenum and stomach This collapsed loop of large gut between the two constrictions was an interesting example of a blind collapsed loop with obstruction at either end

Small Intestine—This was uniformly greatly distended Portions of the lower ileum and the beginning of the jejunum had a mottled, purplish color There was no distinctly gangrenous gut There were no perforations apparent

Discussion—This case presented an interesting problem in differential diagnosis It was another example of the fact that two pathologic entities, *i e*, hemorrhoids and adhesive bands, can cause bleeding per rectum and intestinal obstruction, as do the much more commonly occurring neoplasms of the rectosigmoid

REFERENCES

[1] Klingenstein, Percy Some Phases of the Pathology of Appendices Epiploicae with Report of Four Cases and Review of the Literature Surg, Gynec & Obstet, 38, 376, 1924

[2] Hunt, V C Torsion of Appendices Epiploicae Annals of Surgery, 69, 31–46, 1919

[3] Riedel Ueber die Drehung der Appendices Epiploicae und ihre Folgen (Unpora Aliens und Strainge im Bauche) Munchen Med Wchnschr, 52, 2308–2311, 1905

[4] Patterson, Daniel C Appendices Epiploicae and Their Surgical Significance, with Report of Three Cases New Eng Jour Med, 209, No 25, 1255–1259, December 21, 1933

[5] Hamilton, Thos Two Cases of Torsion of an Appendix Epiploicae Med Jour Australia, 1, No 22, 773, May 28, 1932

[6] McIver, M A Acute Intestinal Obstruction Amer Jour Surg, 19, 163–206, January, 1933

GUNSHOT WOUND OF RIGHT ILIAC BONE *

COMPLICATED BY UNCONTROLLABLE SINUSES OF RIGHT GLUTEAL REGION

SIGMUND MAGE, M D
NEW YORK, N Y

Case Report—An Italian, age 41, received on January 29, 1916, a gunshot wound of the lower abdomen, the bullet traversed the right iliac fossa and pierced the right iliac bone An immediate abdominal exploration was performed at the Volunteer Hospital, New York City, the findings of which we have never been able to ascertain

Two days later the bullet was removed from the subcutaneous tissues of the right gluteal region, through an incision which remained the site of a persistent draining sinus He apparently was free of any discomfort until December, 1926, when he was admitted to the Beekman Street Hospital for the incision and drainage of a large right gluteal abscess, which seemed to originate in the region of a defect in the iliac bone created by the bullet (Fig 1) Ever since then he has been under more or less continuous observation for recurrent abscesses and an increasing number of draining sinuses His hospital admissions were December, 1926, July, 1929, March, 1931, September, 1932, January, 1933, and finally April, 1935

All efforts to control the spread of the infection or to discover its cause have been unsuccessful On two occasions the defect in the ilium was fully exposed and found to be a clean cut, rigid walled opening, without evidence of acute infection in the surrounding bone—curettings from which merely revealed a very low grade osteitis No foreign body was discovered Repeated cultures of the discharge from sinus tracts usually returned a gram-negative bacillus of the *B coli* group Anaerobic cultures were negative There was never any clinical or roentgenologic finding of a gastrointestinal origin Tuberculosis and mycotic infections were suspected and sought without result

Although the patient's general condition did not suffer materially, he was economically incapacitated because of the local condition On his last admission in April, 1935, there were at least 70 sinuses distributed over the right gluteal area, extending posteriorly to the left lumbar region and anteriorly to the right iliac fossa (Fig 3A and B) It was then felt that two possible factors for the persistence of the infection had to be eliminated (1) A foreign body on the inner aspect of the iliac bone (2) The defect in the iliac bone, inasmuch as the recurrent abscesses and sinuses seemed to originate in or about its site It was decided that removal of a segment of ilium, which included the defect, might accomplish both these objectives

Operation—April 27, 1935 An incision was made along the crest of the right ilium, extending from the anterior superior to the posterior superior iliac spine, mobilizing the gluteal muscles A triangular segment of bone, 10 cm at its base, 2½ cm at its apex and 7½ cm on its side, was excised (Fig 2) Grossly, it showed nothing remarkable, and microscopic examination revealed only a very low grade osteitis with more of a tendency to a reparative reaction than an inflammatory one The underlying psoas-iliacus muscles showed considerable fibrotic changes, but no sinus tracts were noted extending inwardly and no foreign body was found The exposed area was packed and allowed to granulate

The many sinus tracts, which literally honey-combed the gluteal muscles and which in themselves were possible factors for the persistence of the infection, were destroyed by a number of subsequent procedures, in which all detectable tracts were fully exposed, cauterized and then allowed to granulate from below up The patient

* Presented before the New York Surgical Society, February 24, 1937 Submitted for publication May 22, 1937



FIG 1.—Roentgenogram showing the defect in the right iliac bone created by the bullet



FIG 2.—Postoperative roentgenogram drawing the extent of the wedge shaped resection of the right iliac bone

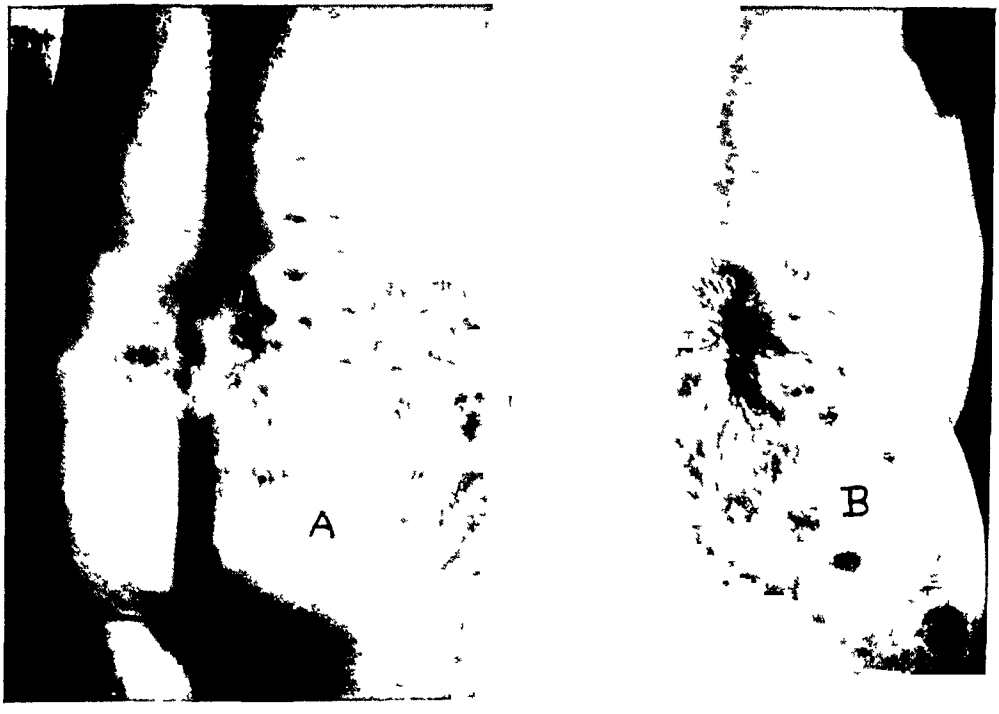


FIG 3.—(A) Photograph, prior to resection of the right iliac bone, showing the posterior appearance of the multiple draining sinuses (B) Lateral view

was discharged to the O P D September 14, 1935, after a hospitalization of 142 days, with extensive granulating wounds which were finally healed by July, 1936 (Fig 4A and B) We had thought we had effected a temporary arrest of the infection because, for the first time in 21 years, the patient had gone for a period of over six months with all the sinuses completely healed Examination, February 24, 1937, however, revealed a recurrence of activity and we are presenting the case for interpretation of the pathology and for advice as to future therapy

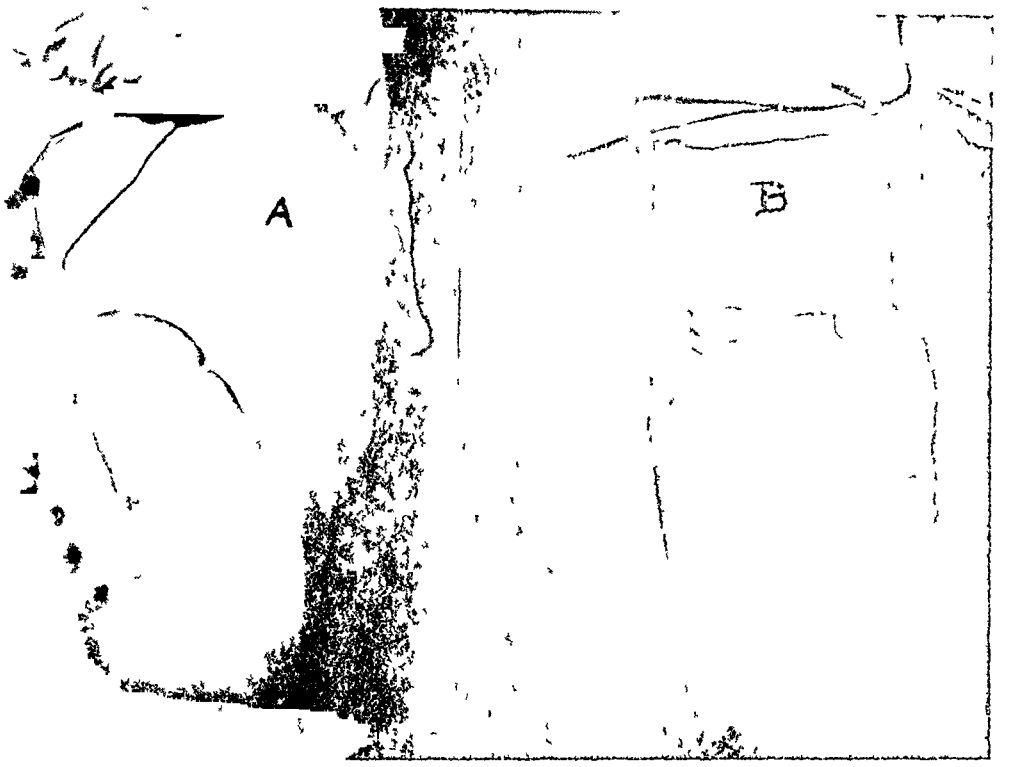


FIG 4.—(A) Photograph, subsequent to resection of the right iliac bone, showing the lateral appearance of the right hip after the sinus had healed (B) Posterior view

While the clinical behavior of this case may be characteristically that of an osteomyelitis of the iliac bone, its mode of onset, gross, microscopic and roentgenologic findings have not been so The microscopic sections have shown a very low grade of osteitis, characterized by occasional collections of mononuclear cells and a distinct tendency toward repair rather than activity The evidence of a bone infection has been most meager and certainly not in proportion to the clinical manifestations On the theory that the defect caused by the bullet might have mechanically been responsible for keeping up a low grade infection, we attempted a radical extirpation of the bone about that area A complete iliectomy may be necessary, on the basis of the available evidence, but it is difficult to see any particular reason for a more hopeful outcome resulting from that procedure Despite most careful and thorough search, it is conceivable that this condition may still be dependent upon an undetected foreign body However, we do not feel justified in further extensive investigation unless that possibility becomes more tangible

DISCUSSION —DR ROBERT H KENNEDY (New York) stressed the importance of Doctor Mage's case of chronic osteomyelitis of the ilium from the economic point of view The patient has been under hospital treatment for 21 years At first, when he presented himself at Beekman Street Hospital 11 years ago, it seemed simple to make a diagnosis Osteomyelitis from an old gunshot wound However, this was not verified by the roentgenologic findings It was thought that a foreign body might be present and this possibility was investigated No foreign body was found A vain search was made for actinomycosis, tuberculosis, and even for a foreign body in the abdomen The patient developed one sinus after another Then Doctor Mage decided that infection was being kept up because there was a rigid cavity He tried to take away some of the rigidity by resecting bones The pathologist could report only osteitis Doctor Kennedy was not quite convinced that there was sufficient evidence to justify removing the rest of the flare of the ilium which was done rather recently, but whether this be so or not, one point was brought out When there is an osteomyelitis, it is important in the early stages to perform just as radical a procedure as may seem necessary, in the hope of earlier cure

MEMOIR

FRANCIS ALEXANDER CARRON SCRIMGER

1880-1937

THE American Surgical Association desires to give expression to its deep sense of loss in the death of Dr Francis Alexander Carron Scrimger, V C,



FRANCIS ALEXANDER CARRON SCRIMGER, M D

of Montreal, who died suddenly on February 13, 1937, in his fifty-seventh year, of coronary thrombosis He had been a member of this Association since 1930

Educated at McGill University, where he received his B A degree in 1901, and his medical degree in 1905, Doctor Scrimger started his postgraduate training in the Royal Victoria Hospital, where he was for three years an intern in the Departments of Medicine and Surgery, and then studied in Europe for a year, principally in Dresden and Berlin Upon his return to Montreal he was appointed to the surgical staff of the Royal Victoria Hospital, where he soon gave evidence of his excellent clinical knowledge and of the investigative spirit which always characterized his surgical career

When war broke out he was appointed Medical Officer to the 14th Battalion, and left with the first contingent from Canada While in charge of a field dressing station at the second battle of Ypres he was awarded the Victoria Cross for distinguished bravery Later he served at the base with the Canadian General Hospital No 1, at Étaples, then with the Granville Hospital, in England, and again in charge of the McGill Unit, No 3 Canadian General Hospital, at Boulogne, with the rank of Lieutenant-Colonel His war service lasted nearly five years Upon demobilization he returned to Canada and rejoined the staff of the Royal Victoria Hospital His career from that time on was one of steady, quiet advance along clinical lines, and resulted in several important achievements in research In 1936, he was appointed Chief Surgeon to the Hospital, and Associate Professor of Surgery at McGill University

Doctor Scrimger possessed a great capacity for friendship and had a wide circle of close friends He was particularly valued as a consultant by his medical confreres because of his wide knowledge, his diagnostic ability, his general soundness and clearness of view, and his unusual skill as an operator

On this continent and in the Old Country he had many friends and was known as one of Canada's outstanding surgeons This reputation was recognized by his election to membership in the most important surgical societies of this continent, among them the American College of Surgeons, the American Association for Thoracic Surgery, the International Society of Surgery, the Interurban and the Halsted Societies

We, his confreres in the American Surgical Association, wish to record our very real sorrow at his death EDWARD W ARCHIBALD

EDITORIAL ADDRESS

Original typed manuscripts and illustrations submitted to this Journal should be forwarded prepaid at the author's risk, to the Chairman of the Editorial Board of the ANNALS OF SURGERY

Walter Estell Lee, M D
1833 Pine Street, Philadelphia, Pa

Contributions in a foreign language when accepted will be translated and published in English

Exchanges and Books for Review should be sent to James T Pilcher, M D, Managing Editor, 121 Gates Avenue, Brooklyn, N Y

Subscriptions, advertising and all business communications should be addressed

ANNALS OF SURGERY
227 South Sixth Street, Philadelphia, Pa

For the same identical reason . . .



that a hunter leans toward a favorite gun that a fisherman favors a pet rod that a golfer clings to an endeared club—surgeons adopt B-P Rib-Back blades as their final choice *Preference born of confidence!*

BARD-PARKER
Rib-Back Blades

offer superior qualities of uniformly keen cutting edges, rigidity and strength—characteristics designed to encourage pressure constancy in surgical touch, thus to gain and retain the confidence of their users

Authentic Rib-Back blades, of which there are eight practical patterns, may be readily identified by our name or trademark "B-P" appearing on every blade and genuine knife handle This identification is your constant assurance of undeviating performance expectancy at all times

Ask your dealer

BARD-PARKER COMPANY, INC.
DANBURY, CONNECTICUT

It's Sharp

A BARD-PARKER PRODUCT

STANDARD BOOKS FOR SURGEONS

NEW WORK *JUST READY*

THE OCULAR FUNDUS IN DIAGNOSIS AND TREATMENT

By DONALD T ATKINSON, M D , F A C S

Consulting Ophthalmologist to the Santa Rosa Infirmary and the Nix Hospital San Antonio, Texas, Fellow of the American Academy of Ophthalmology and Oto-Laryngology

Imperial octavo, 259 pages, illustrated with 106 engravings including 58 colored plates
Cloth, $10 00, net

This work clearly outlines the general characteristics of the ocular fundus in health and disease It is invaluable to everyone who uses the ophthalmoscope in diagnosis—to neurologists, obstetricians and surgeons as well as to ophthalmologists Its outstanding feature is the inclusion of 58 colored plates prepared by the author, who is himself an artist and produces exactly what he interprets from the fundus and hence pre sents a more accurate picture than could a professional artist working from descriptions Each plate is accom panied by descriptive matter, necessarily brief, but showing the clinical findings and laboratory reports that have a direct bearing upon the conditions illustrated In addition to these colored plates there are 48 draw ings in black and white also prepared by the author This comprehensive, well organized material will be a distinct aid in the diagnosis of conditions revealed by the ophthalmoscope

ENDOCRINOLOGY

Clinical Application and Treatment

By AUGUST A WERNER, M D , F A C P

Assistant Professor of Internal Medicine St Louis University School of Medicine Associate Physician, St Mary's Group of Hospitals, Physician, Endocrine Clinic St Louis City Hospital Staff Member, St Louis City Hospital Sanitarium and Infirmary , etc

Octavo, 672 pages, illustrated with 265 engravings Cloth, $8 50, net

The purpose of this work is to make clinical endocrinology more understandable to the physician, to point the way to correct diagnosis and to offer help in the relief of these ailments The author presents a review of the anatomical structure and arrangement of the autonomic nervous system and the functions of the endocrine glands Metabolism and the influence of the glands are then discussed, the functions of the endocrines are considered and known or postulated hormones are identified In the treatment of endocrine con ditions the author advocates only those preparations and methods which have proven their efficiency This book summarizes what is actually known in endocrinology, systematizes our present knowledge of the normal and abnormal physiology of the ductless glands and applies this information to the recognition of the endocrine syndromes The work is a safe and conservative guide to both diagnosis and treatment

SURGICAL DISEASES OF THE CHEST

By EVARTS A GRAHAM, A B , M D , F A C S
Professor of Surgery, Washington University School of Medicine Surgeon-in-Chief, Barnes Hospital, St Louis, Missouri

JACOB J SINGER, M D., F A C P
Associate Professor of Clinical Medicine Washington University School of Medicine Assistant Physician, Barnes Hospital, St Louis, Missouri

HARRY C BALLON, M D , C M , F A C S
Formerly Assistant Professor of Surgery, Washington University School of Medicine St Louis, Formerly Assistant Surgeon, Barnes Hospital St Louis Missouri

Imperial octavo, 1070 pages, illustrated with 637 engravings Cloth, $15 00, net

The field of thoracic surgery is one that is expanding so rapidly that a continued revision of the manu script has been necessary to keep it fully abreast of the new knowledge In its present form it reflects every advance to the date of publication Its authors are recognized authorities and their book summarizes their unusual experience in the field of thoracic surgery While less emphasis is placed on the surgical technique and on the actual features of the operation, than in most books designed exclusively for surgeons, the essen tial aspects of the operative surgical procedures have not been neglected and many of the operations have been described and illustrated in detail

LEA & FEBIGER

WASHINGTON SQUARE
PHILADELPHIA, PA

Please send me books checked

☐ Atkinson's The Ocular Fundus $10 00

☐ Werner's Endocrinology 8 50

☐ Graham, Singer & Ballon on Surgical Diseases of the Chest $15 00

☐ Catalogue

Name

Address

(A of S 1-38)

Please mention ANNALS OF SURGERY when writing advertisers

Lowsley & Kirwin—UROLOGY FOR NURSES

This new book adequately answers the urgent demand for a text in Urology which not only covers the basic science but also stresses the newer refinements of practice as well as presenting the Nursing factors in proper detail The methods are based on more than fifteen years of experience in a large, modern urological clinic through which thousands of patients pass annually Every instrument and method here described has been put to the severest test of actual usage The material is readily accessible to the teaching nurse, student and busy graduate It has a chapter on special instruments and equipment, instructions regarding their care Special emphasis is placed upon the part of the nurse in pre-operative and post-operative care, which, in such procedures as prostatectomy, is often as important as the operation itself The nurse's work in the operating and cystoscopic room in the preparation, assistance and care of the instruments after use is described in detail It has a chapter on diet and glossary

Octavo 493 pages 101 illustrations Cloth, $3 00

By OSWALD SWINNEY LOWSLEY, M D, Director, Department of Urology (James Buchanan Brady Foundation), New York Hospital, and THOMAS JOSEPH KIRWIN, M D, Attending Surgeon, Department of Urology (James Buchanan Brady Foundation), New York Hospital

J. B. LIPPINCOTT COMPANY

Dept AS Washington Square Philadelphia

Drink

Coca-Cola

Delicious and Refreshing



Pure refreshment

The Journal of Bone and Joint Surgery

The Official Publication of the
American Orthopaedic Association
British Orthopaedic Association
American Academy of Orthopaedic Surgeons
Owned and published by the American Orthopaedic Association

Published Quarterly:
January, April, July, and October

The only publication in English dealing exclusively with bone and joint conditions

Through the cooperation of its Foreign Editors, its pages include contributions from recognized leaders in this specialty from foreign countries as well as from the United States and Canada

In the choice of papers for publication emphasis is laid on the practical and clinical subjects

A journal of value to general surgeons as well as to those dealing with the problems of orthopaedic and traumatic surgery

Editor, E. G. BRACKETT, M.D.
8 THE FENWAY, BOSTON, MASSACHUSETTS, U. S. A.

ORDER BLANK

THE JOURNAL OF BONE AND JOINT SURGERY
8 The Fenway, Boston, Massachusetts

Please enter my subscription to THE JOURNAL OF BONE AND JOINT SURGERY for one year beginning with the issue for

☐ Enclosed find $——— in payment ☐ Will remit on receipt of bill

NAME STREET

CITY STATE

Subscription Price—Payable in Advance—$5 00 in the United States, $5 25 in Canada, $5 75 in Foreign Countries

Please mention ANNALS OF SURGERY when writing advertisers

"REQUIRED READING"

Your Personal Guide to a More Successful Practice

Dr George D Wolf is a highly successful physician who decided it was high time that someone put out a book that showed the doctor how to put his profession on a more profitable basis The result is one of the most important books any doctor can have—a book that answers and clarifies hundreds of questions and problems regarding business ethics and economics constantly confronting the busy doctor

The volume should be carefully read by the physician s secretary or office nurse as well, as much of the information and sug gestions tendered in it can be applied and put into service without any instruction from the doctor whatsoever There is also a particularly useful section devoted to mate rial teaching nurses how to give instruc tions to patients for home self-treatment Nothing has been omitted It is all there for you—from How to make a Radio Talk to How to Give Expert Court Testimony Every doctor will find a single reading worth many times the book s cost to him Price only $5 00

DO YOU KNOW

How to go about collecting money from patients who fail to pay?
How to make your office secretary or nurse do many of the things you now must do yourself?
How to equip and plan your office to make it most efficient?
How to pick a profitable location and lay out your office?
How to avoid lawsuits?
How to keep records for your income tax?

THE PHYSICIAN'S BUSINESS

by

GEORGE D. WOLF, M.D.

Attending Otolaryngologist, Sydenham Hospital, New York City Attending Laryngologist, River side Hospital, New York City, Fellow, New York Academy of Medicine, Fellow, American Medical Association, etc

Ready Soon!

"There is no finer book on the subject"

Dr Bacon s new book is comprehensive, practical and authoritative It offers an unbiased, informative descrip tion of the diversified conditions included in proctologic practice, and covers every phase of the subject It emphasizes the application of the procedure to the pa tient—not the patient to the procedure *487 illustrations (mostly originals) crisply picture the author's wide clinical and surgical experience*

Dr Bacon s text stresses the underlying pathology of the Anus, Rectum and Sigmoid Colon as basic to treatment He describes the various methods of exami nations Diseases are detailed, giving Definition, Etiology, Symptoms, Diagnosis, Medical and/or Surgical Treatment Particular attention is given to Hemorrhoids and to Tumors, including infectious, benign and malignant tumors of the sigmoid and rectum A comprehensive, selected bibliography completes each chapter 600 pages 487 illustrations

ANUS, RECTUM AND SIGMOID COLON

Diagnosis and Treatment

by

HARRY E. BACON, M.D.

F A C S, F A P S, Assistant Professor of Proctology, Temple University School of Medicine, Associate in Proctology, Graduate School of Medicine, University of Penn sylvania

Foreword by

J P LOCKHART-MUMMERY, M A, M B, B Ch (Cantab), F R C S (Eng), Emeritus Surgeon, St Mark's Hospital, London, England

Published by

J. B. LIPPINCOTT COMPANY

Washington Square Philadelphia



Enjoy the Comfort and Prestige of

PHILADELPHIA'S FOREMOST HOTEL

Treat yourself to the best when you visit Philadelphia .stop at the Benjamin Franklin Big, comfortable rooms with every modern comfort Enjoy food that's an epic for epicures Save time and annoyance through the Benjamin Franklin's convenient location Yet all this costs you no more than ordinary hotel comfort and service



The BENJAMIN FRANKLIN

PHILADELPHIA'S FOREMOST HOTEL

Samuel Earley · MANAGING DIRECTOR



Look at winter's sunnier side from this friendly beachfront location

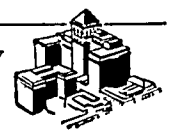
Statistics show more than the average share of sunshine here Golf is a year-round sport The bracing salt air keeps a snow-free Boardwalk

Life is sunnier, too within these Boardwalk hotels There's lots to do Game rooms, squash courts, badminton, concerts, dances Entertainment The rooms are bright and roomy Comfortable seaside lounges Health baths Tempting wholesome food

LEEDS AND LIPPINCOTT COMPANY

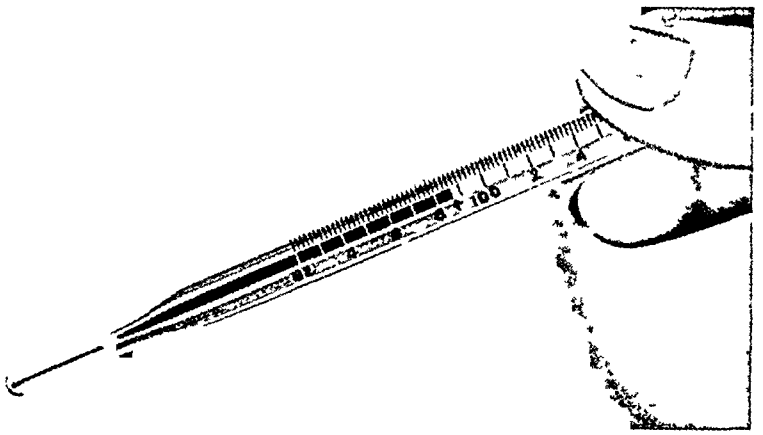
CHALFONTE-HADDON HALL

ATLANTIC CITY



★ ★ ★ ★

FOUR STAR PRODUCTION BY TAYLOR



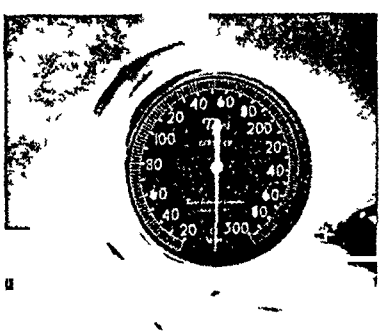


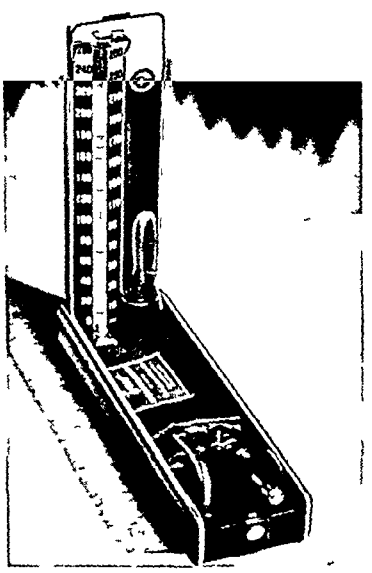
NEW BINOC FEVER THERMOMETER

Triple-lens construction concentrates more light on the mercury column, makes readings much easier Flattened glass tube is easier to hold under tongue more convenient to shake down Oral and rectal types Each in handsome case with gold-plated band and clip Taylor-Tycos BINOC is $2 00, Taylor BINOC $1 50

DESK-MODEL TYCOS ANEROID

A smart-looking instrument Easily read at distance of six feet Carries same 10-Year Guarantee as the Portable Tycos Aneroid Available also as Wall Model $27 50 complete





CERTIFIED TYCOS PORTABLE ANEROID

Half the size of a mercurial Never requires testing for accuracy Carries 10-Year Triple Guarantee that it will remain accurate in normal use will tell instantly if thrown out of adjustment and will be corrected without charge if thrown out of adjustment $25 00 complete

TYCOS MERCURIAL

The smallest mercurial available today Ten-year guarantee covers free replacement of glass tube and breakage or mechanical failure of case or any part (except accessories) No time limit on guarantee of accuracy $27 50 complete

GO TO YOUR SURGICAL SUPPLY DEALER'S AND SEE THESE MODERN INSTRUMENTS
TAYLOR INSTRUMENT COMPANIES, ROCHESTER, N Y, OR TORONTO, CANADA

Tycos SPHYGMOMANOMETERS AND BINOC FEVER THERMOMETERS

REG U S PAT OFF



Professional Approval

Ortho-Gynol is prescribed by physicians because of its professional background Gynecologists have found Ortho-Gynol a reliable, scientific preparation Ortho-Gynol is available for discriminate prescription in Package "C"—an unlettered package with measured dose applicator—and Package "D", without applicator

A PRODUCT OF JOHNSON & JOHNSON

© 1938 JOHNSON & JOHNSON

ortho-gynol

FOR VAGINAL HYGIENE

VOL 107 FEBRUARY, 1938 NO 2

ANNALS of SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

Also the Official Publication of the American Surgical Association, the Southern Surgical Association, Philadelphia Academy of Surgery, and New York Surgical Society

EDITORIAL BOARD

WALTER E LEE, M D
Chairman, *Philadelphia*

BARNEY BROOKS, M D
Nashville, Tenn

E D CHURCHILL, M D
Boston, Mass

EVARTS A GRAHAM, M D
St Louis, Mo

ROSCOE R GRAHAM, M D
Toronto, Canada

SAMUEL C HARVEY, M D
New Haven, Conn

ROY D McCLURE, M D
Detroit, Mich

GEORGE P MULLER, M D
Philadelphia

H C NAFFZIGER, M D
San Francisco, Cal

D B PHEMISTER, M D
Chicago, Ill

W F RIENHOFF, JR, M D
Baltimore, Md

A O WHIPPLE, M D
New York

JAMES TAFT PILCHER, M D, Managing Editor

J B LIPPINCOTT COMPANY, *Publishers*

PHILADELPHIA MONTREAL LONDON NEW YORK

Entered at the Post Office at Philadelphia and admitted for transmission through the mails at second class rates Price $10 00 a year Copyright 1938, by J B Lippincott Company, 227–231 South Sixth Street Printed in U S A

CONTENTS

Vol. 107 FEBRUARY, 1938 No 2

ACUTE INTESTINAL OBSTRUCTION — John Scudder, M D; Raymund L Zwemer, M D; Allen O Whipple, M D — New York N Y — 161

SHORT-INTERVAL STAGE OPERATIONS FOR SEVERE HYPERTHYROIDISM — Arthur B McGraw, M D — Detroit Mich — 198

FACTORS INFLUENCING PROGNOSIS IN CARCINOMA OF THE BREAST — Herbert H Davis, M D — Omaha Nebr — 207

INTRATRACHEAL SUCTION IN THE MANAGEMENT OF POSTOPERATIVE PULMONARY COMPLICATIONS — Cameron Haight, M D — Ann Arbor Mich — 218

SPONTANEOUS CHOLEDOCHOGASTROSTOMY AND CHOLECYSTOGASTROSTOMY — Marshall Davison, M D; Leon J Aries, M S, M D — Chicago Ill — 229

STONES IN THE COMMON BILE DUCT — Frank C Beall, M D — Fort Worth Texas — 238

APPENDICITIS IN ARMY SERVICE — Raymond W Bliss, M D; Leonard D Heaton, M D — El Paso, Texas — 242

VOLVULUS OF THE CECUM AND ASCENDING COLON — Mandel Weinstein, M D — Long Island City N Y — 248

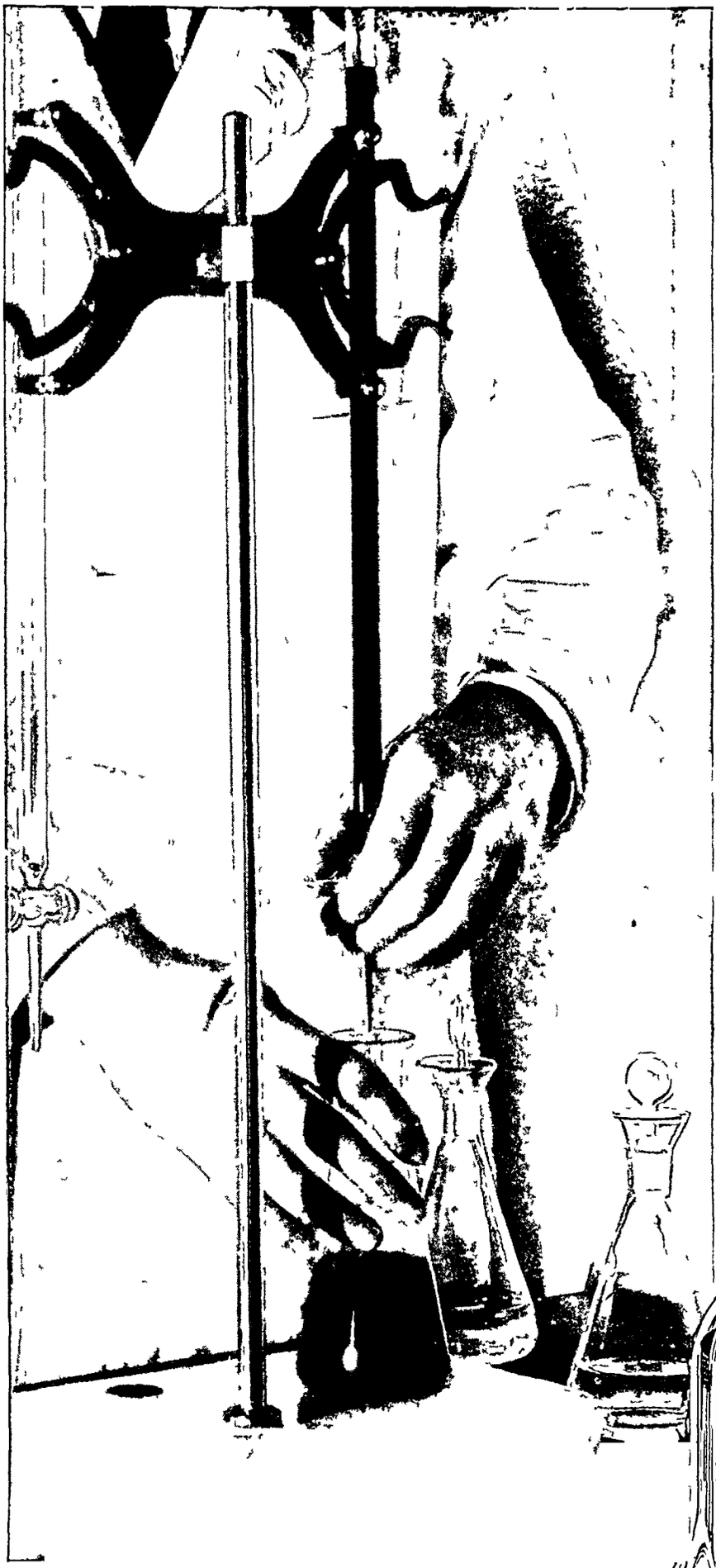
ARGENTAFFINE TUMORS OF THE GASTRO-INTESTINAL TRACT — Thomas E Wyatt, M D — Nashville Tenn — 260

THE MECHANISM OF SPASTIC VASCULAR DISEASE AND ITS TREATMENT — Peter Heinbecker, M D; George H Bishop, Ph D — St Louis Mo — 270

NEOPLASMS OF THE ABDOMINAL WALL — Joseph A Lazarus, M D — New York N Y — 278

BLOOD LOSS IN NEUROSURGICAL OPERATIONS — J C White, M D; G P Whitelaw, M D; W H Sweet, M D; E S Hurwitt, M D. — Boston Mass — 287

(*Contents continued on page 4*)



No dextrose solutions are produced under government license, but . . .

Saftiflasks are backed by a government-licensed biological laboratory

Unlike biologicals, no law exists which permits the government to license their production But at Cutter Laboratories, with a background of *forty years* experience in the production of products for safe intravenous injection, these unlicensed solutions receive the same exacting care in production and testing as biologicals

Like biologicals, dextrose solutions in Saftiflasks are produced with scientific skill and knowledge They are tested and re tested chemically, bacteriologically, physiologically by technicians of the calibre demanded in government-licensed biological laboratories, by workers wholly divorced from the manufacture of the products tested Specify dextrose solutions *in Saftiflasks*

CUTTER LABORATORIES
Berkeley, California 111 No Canal Street, Chicago
(U S Govt License No 8)



Saftiflasks

CONTENTS—*Continued*

GIANT CELL TUMOR OF THE CERVICAL SPINE — DeForest P Willard, M D; Jesse Thompson Nicholson, M D — Philadelphia Pa — 298

RATIONALE OF BONE DRILLING IN DELAYED AND UNUNITED FRACTURES — Proviso V Prewitt, M D; E R Easton, M D — New York N Y — 303

BRIEF COMMUNICATIONS AND CASE REPORTS

STAB WOUND OF THE HEART TWENTY-ONE YEARS AFTER SUTURE — John F X Jones, M D — Philadelphia Pa — 311

AN AMBULATORY TREATMENT OF FRACTURE OF THE PATELLA — Eugene St Jacques, M D — Montreal Canada — 311

MEMOIR

INGERSOLL OLMSTED — Donald C Balfour, M D — 314

BOOK REVIEWS

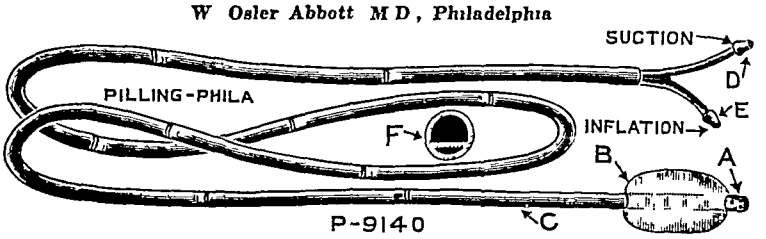
POSTGRADUATE SURGERY — Charles Gordon Heyd, M D — 316

THE MANAGEMENT OF FRACTURES, DISLOCATIONS AND SPRAINS — Robert L Preston, M D — 319

BOOKS RECEIVED — 320

DOUBLE LUMEN TUBES FOR SMALL INTESTINAL INTUBATION

T Greer Miller M D, F A C P
and
W Osler Abbott M D, Philadelphia



This double channel tube principle is used for three special purposes First for treating and diagnosing obstructive lesions of small intestines second for controlling patient with intestinal obstruction by enabling him to feed yet to draw off residue above point of blockage third for use after gastro enterostomy

As shown in the illustration one lumen of the tube is used to inflate the balloon the other entirely independent for feeding or aspiration and inflation of the balloon stimulates peristalsis to propel the apparatus through the whole small intestine in from three to four hours

The terminal balloon may be distended to cause active peristalsis capable of carrying the tip of the tube to the cecum in four hours in a normal individual or at a slower rate in a case of intestinal obstruction

By attaching the lumen leading to the balloon to a recording instrument a tracing of intestinal activity that may be of diagnostic significance can be obtained

Suction applied to the larger lumen will empty the intestine in a normal case or in a case of intestinal obstruction

The lumen used for suction may also be used for the injection of barium sulphate suspension in making roentgenological studies of small intestinal lesions

P9140 Abbott double lumen tube (No 11) with balloon proximal to perforated metal end see illustration
P9142 Abbott tube similar to above (No 3) with the balloon distal to the perforated metal end
P9144 Abbott tube for use after gastro enterostomy (No 12) double lumen with perforated metal and piece but without balloon

(See Journal of American Medical Association January 4 1936)

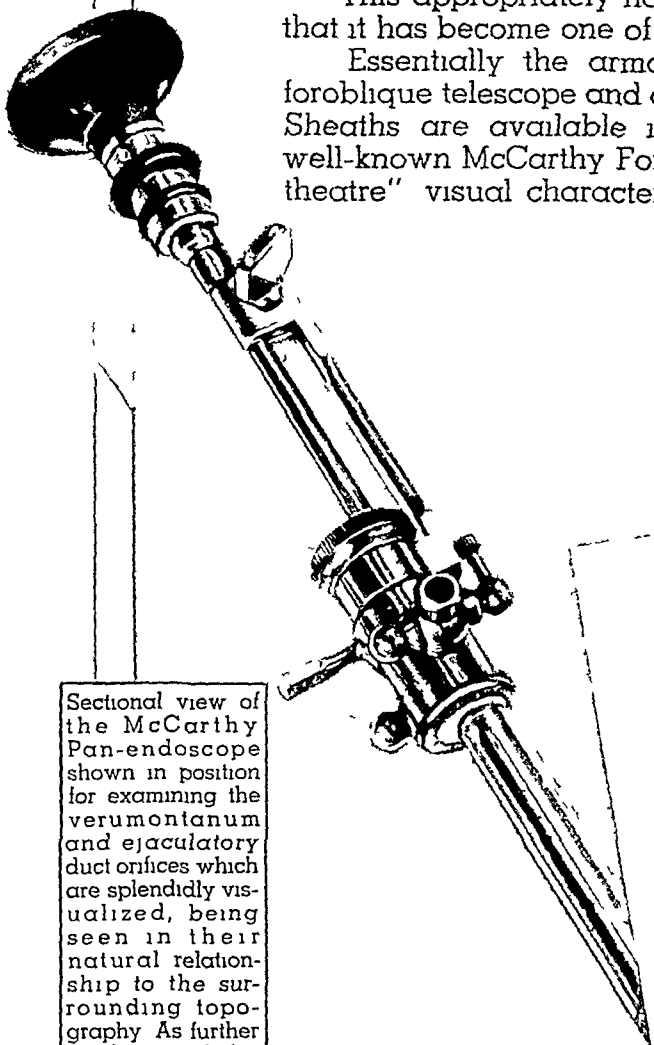
GEORGE P PILLING & SON CO
ARCH & 23rd PHILADELPHIA

Please mention ANNALS OF SURGERY when writing advertisers

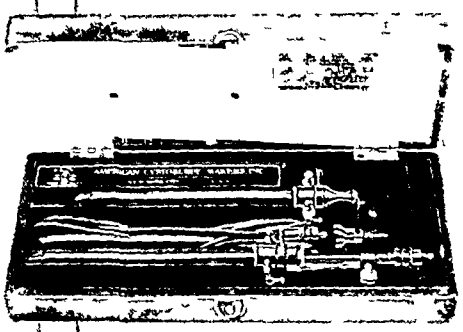
McCarthy Foroblique Pan - endoscope

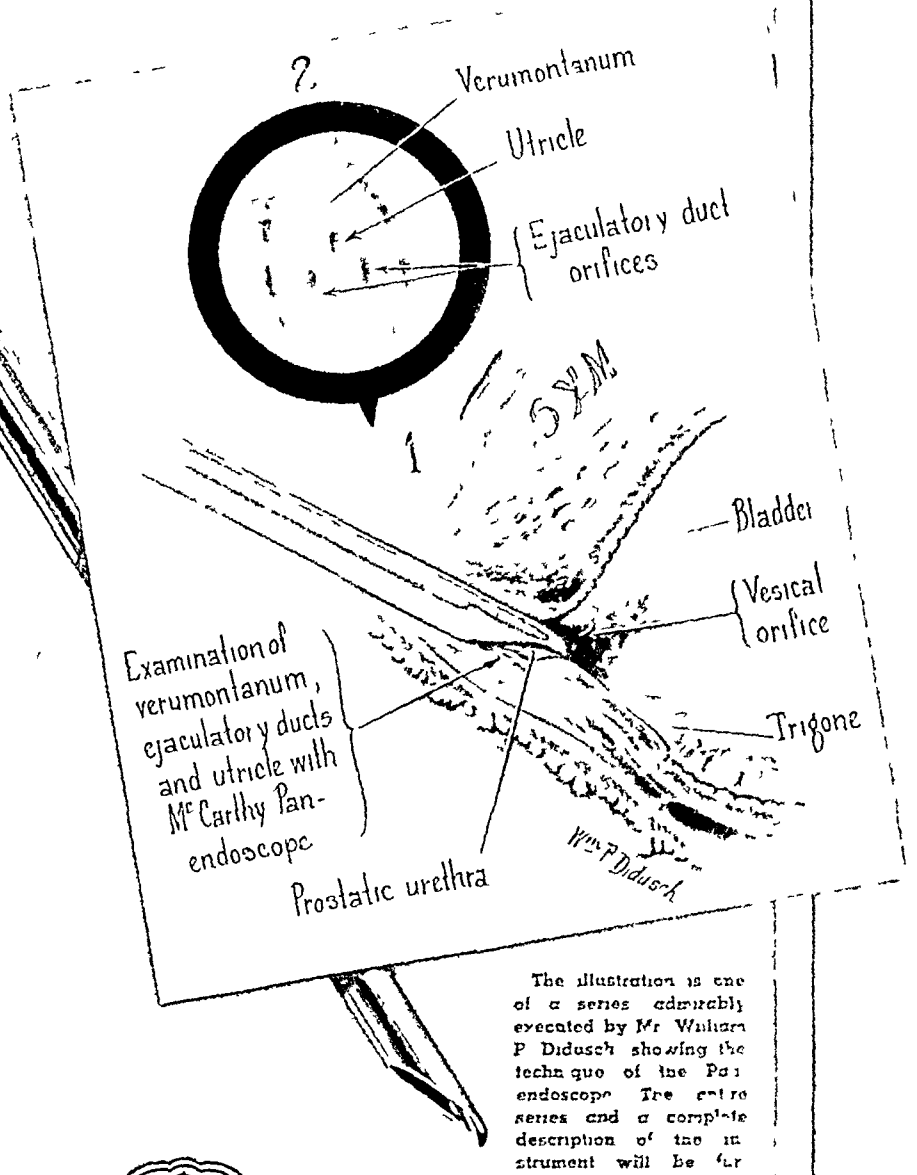
This appropriately named cystoscope possesses such broad utility that it has become one of the most widely used instruments in urology

Essentially the armamentarium consists of straight sheaths, a foroblique telescope and a bridge assembly for relating these elements Sheaths are available in sizes 16 to 30 Fr The telescope is the well-known McCarthy Foroblique system noted for its natural, "amphitheatre" visual characteristics



Sectional view of the McCarthy Pan-endoscope shown in position for examining the verumontanum and ejaculatory duct orifices which are splendidly visualized, being seen in their natural relationship to the surrounding topography As further evidence of the wide utility enenjoyed by this instrument, precise bladder inspection as well as examination of the urethra are possible





The illustration is one of a series admirably executed by Mr William P Didusch showing the technique of the Pan endoscope The entire series and a complete description of the instrument will be furnished upon request

ESTABLISHED IN 1900 BY REINHOLD H WAPPLER

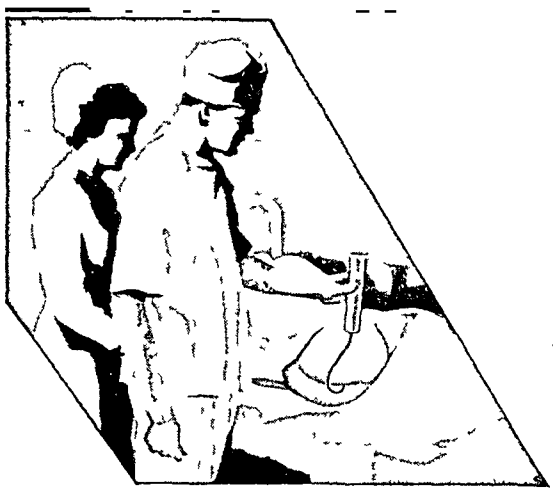
FREDERICK C WAPPLER PRESIDENT

AMERICAN CYSTOSCOPE MAKERS, INC.

450 WHITLOCK AVE NEW YORK U S A.

A NEW ANTISEPTIC

Almost a Decade of Steady Progress in Basal Anesthesia by the Rectal Method



AVERTIN

with

AMYLENE HYDRATE

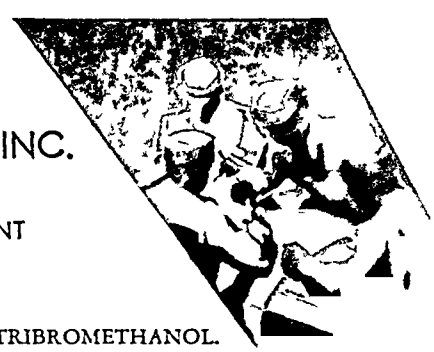
SINCE the introduction of Avertin with Amylene Hydrate for basal anesthesia, approximately 400 reports on its use in general surgery, gynecology, obstetrics and other specialties have been published in North American journals In many of our largest hospitals this method of basal anesthesia is now employed daily

Avertin with Amylene Hydrate appeals so favorably to patients, anesthetists and surgeons because they appreciate that this method provides satisfactory basal anesthesia Write for booklet "Avertin with Amylene Hydrate" (recently revised), giving detailed information regarding dosage and manner of use, signs and symptoms of basal anesthesia and the postoperative stage, the use of supplemental anesthesia in reduced dosage, as well as indications and contraindications

Avertin with Amylene Hydrate is supplied in bottles of 25 cc and 100 cc (each 1 cc containing 1 Gm of Avertin)

The pamphlet on Avertin with Amylene Hydrate is sent free to physicians on request

WINTHROP



WINTHROP CHEMICAL COMPANY, INC.

Pharmaceuticals of merit for the physician

NEW YORK N Y WINDSOR, ONT

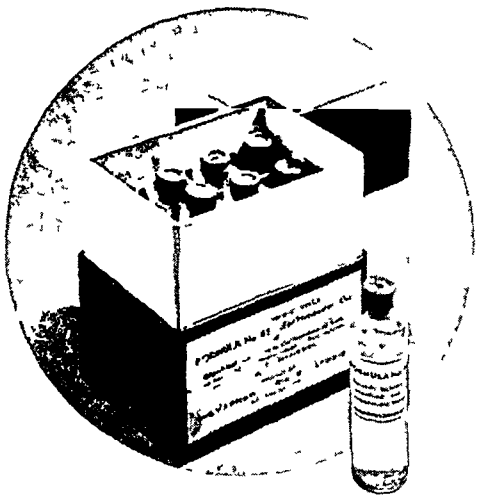
Factories Rensselaer, N Y —Windsor, Ont

AVERTIN, Reg U S Pat Off & Can identifying Winthrop brand of TRIBROMETHANOL.

557AM

FOR VARICOSE VEINS

Hemorrhoids, Varicocele, Hydrocele, etc



Formula No. 61

The action of Formula No 61 is to reinforce the vein wall where necessary so that normal size and function may be regained and retained
Formula No 61 may be injected either intraven ously or extravenously, consequently is indicated in the treatment of "sunburst" types
Write for literature on simplified technic

FARNSWORTH LABS, CHICAGO

Cook County Graduate School of Medicine

(IN AFFILIATION WITH COOK COUNTY HOSPITAL)
Incorporated not for profit

ANNOUNCES CONTINUOUS COURSES

MEDICINE—Informal Course, Intensive Personal Courses, Special Courses

SURGERY—General Courses One Two, Three, and Six Months Two Weeks' Intensive Course in Surgical Technique with practice upon living tissue, Clinical Course, Special Courses

GYNECCLOGY & OBSTETRICS—Diagnostic Courses Clinical Courses, Special Courses

FRACTURES & TRAUMATIC SURGERY—Informal Practical Course Ten-Day Intensive Course starting February 14 1938

OTOLARYNGOLOGY—Two Weeks Intensive Course starting April 4 1938

OPHTHALMOLOGY—Two Weeks Intensive Course starting April 18, 1938, Personal Course in Refraction Methods

UROLOGY—General Course Two Months Intensive Course Two Weeks Special Courses

CYSTOSCOPY—Ten Day Practical Course

GENERAL INTENSIVE AND SPECIAL COURSES IN ALL BRANCHES OF MEDICINE AND SURGERY

TEACHING FACULTY
Attending Staff of Cook County Hospital

Address Registrar 427 South Honore Street
Chicago, Illinois

INDEX TO ADVERTISERS

	Page
SURGICAL SUPPLIES	
American Cystoscope Makers, Inc	5
Kny-Scheerer Corporation	Inside Back Cover
George P Pilling & Son Co	4
Taylor Instrument Companies	25
LIGATURES	
Davis & Geck, Inc	16
Davis & Geck, Inc	Insert 8-9
Johnson & Johnson	15, 28
C De Witt Lukens	16
X-RAY PLATES	
General Electric X-Ray Corp	21
PHARMACEUTICAL SUPPLIES	
Alba Pharmaceutical Company	6
Anglo-French Drug Co, Inc	Inside Front Cover
Ciba Pharmaceutical Products Inc	Back Cover
Cutter Laboratories	3
Farnsworth Laboratory	8
E Fougera & Co, Inc	19
Hoffmann-LaRoche, Inc	12
Eli Lilly & Company	13
Loeser Laboratory	Back Cover
Parke, Davis & Company	9
Petrolagar Laboratories, Inc	11
Purdue Frederick Company	Inside Back Cover
Schering & Glatz, Inc	27
E R Squibb & Sons	14
William R Warner & Co Inc	23
Winthrop Chemical Co, Inc	7
Zonite Products Corp	17
HOTELS	
Benjamin Franklin	22
Chalfonte-Haddon Hall	22
PUBLISHERS	
Journal of Bone and Joint Surgery	24
Lea & Febiger	20
J B Lippincott Company	10, 18, 26
SCHOOLS	
Cook County Graduate School of Medicine	8
Chicago Post-Graduate School of Surgery	10



INCREASED distribution of a product is always gratifying to the producer, particularly when it is attained through a host of users who base their selection on its merits and on faith in the organization back of it.

To us, then, a record year means more than a furtherance of production efficiency. It means that the confidence and good will of old friends has been retained and new friends added. It presents a challenge to display our gratitude, not in words alone, but through progressive policies and practices and in terms of dependability and service.

DAVIS & GECK, INC.

D&G Sutures

"THIS ONE THING WE DO"

Special D&G Sutures

WITH SWAGED-ON ATRAUMATIC NEEDLES

THIS group of products comprises over a hundred suture and needle combinations specially designed for specific procedures, particularly those in which minimized suture trauma and the convenience of needles which cannot possibly become unthreaded, are desirable A few products from this group are shown on these pages Full information on others may be obtained from your dealer or by mail from us, upon request

Intestinal Sutures

KALMERID plain or chromic catgut, celluloid-linen or silk with Atraumatic needles in the several types indicated integrally affixed Suture lengths 36 inches for products 1342, 1352, 1372 and 1542, all others 28 inches

THERMO-FLEX *(non-boilable)*

Plain Catgut

NO		NEEDLE	DOZEN
1501	Straight Needle	A-1	$3 60
1503	3/8-Circle Needle	A-3	4 20
1504	Small 1/2-Circle Needle	A-4	4 20
1505	1/2-Circle Needle	A-5	4 20

20-Day Chromic Catgut

1541	Straight Needle	A-1	$3 60
1542	Two Straight Needles	A-1	4 20
1543	3/8-Circle Needle	A-3	4 20
1544	Small 1/2-Circle Needle	A-4	4 20
1545	1/2-Circle Needle	A-5	4 20

CLAUSTRO-THERMAL *(boilable)*

Plain Catgut

1301	Straight Needle	A-1	$3 60
1303	3/8-Circle Needle	A-3	4 20
1304	Small 1/2-Circle Needle	A-4	4 20
1305	1/2-Circle Needle	A-5	4 20

20-Day Chromic Catgut

1341	Straight Needle	A-1	$3 60
1342	Two Straight Needles	A-1	4 20
1343	3/8-Circle Needle	A-3	4 20
1344	Small 1/2-Circle Needle	A-4	4 20
1345	1/2-Circle Needle	A-5	4 20

Intestinal Sutures *(cont'd)*

Celluloid-Linen

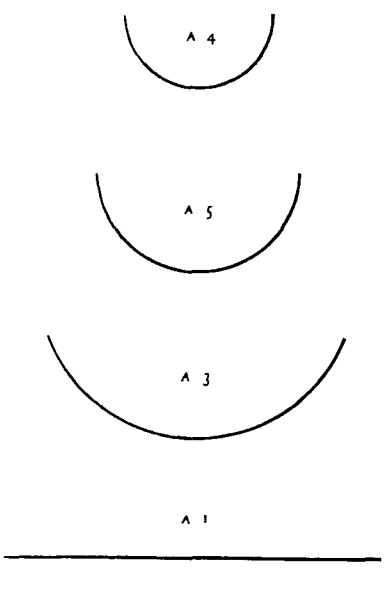
NO		NEEDLE	DOZEN
1351	Straight Needle*	A-1	$3 60
1352	Two Straight Needles*	A-1	4 20
1354	Small 1/2-Circle Needle*	A-4	4 20

Black Silk

1371	Straight Needle*	A-1	$3 60
1372	Two Straight Needles*	A-1	4 20
1374	Small 1/2-Circle Needle*	A-4	4 20

Sizes 00 0 1, except *00 0 only

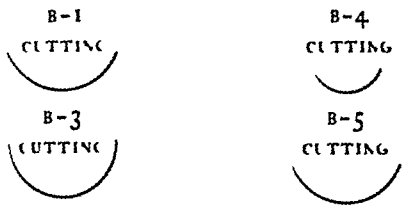
In packages of 12 tubes of a kind and size



DIAMETERS .022 TO .026

Eye Sutures

FINE sizes of plain, 10-day chromic catgut, and black silk with small Atraumatic needles Suture length 18 inches except as noted Boilable



NO	MATERIAL	SIZE	NEEDLE
1661	Black Silk	6-0	B-3
1663	Plain Catgut	4-0	B-5
1665	Black Silk	6-0	B-1
1665	Black Silk	4-0	B-1
1667	Plain Catgut	3-0	B-4
1669	10-Day Catgut	4-0	B-5
1669	10-Day Catgut	3-0	B-5
1669D	10-Day Catgut †	4-0	B-5
1669D	10-Day Catgut †	3-0	B-5
	DOUBLE ARMED		
1662	Black Silk *	6-0	B-3
1664	Black Silk *	6-0	B-1
1664	Black Silk *	4-0	B-1
1666	Plain Catgut *	3-0	B-4
1668	10-Day Catgut *	4-0	B-5
1668	10-Day Catgut *	3-0	B-5
1668D	10-Day Catgut †	4-0	B-5
1668D	10-Day Catgut †	3-0	B-5

* 12 inches † 9 inches

Package of 12 tubes of a kind $4 20

Cleft Palate and Harelip Sutures



NO	MATERIAL	SIZE	NEEDLE
1751	Kal-dermic	00	C-1
1752	Aluminum-Bronze Wire	00	C-1
1753	Black Braided Silk	000	C-2
1754	Aluminum-Bronze Wire	00	C-4
1755	Kal-dermic	00	C-3
1758	Aluminum-Bronze Wire	00	C-3

Suture length 18 inches

Package of 12 tubes of a kind $4 20

Thyroid Sutures

THERMO-FLEX (*non-boilable*) or Claustro-Thermal (*boilable*) catgut, and black braided silk with half-circle, taper point Atraumatic needles Suture length 28 inches



NO	MATERIAL	SIZE	NEEDLE
1635	Non-Boilable Plain Catgut	0	T-1
1625	Boilable Plain Catgut	0	T-1
1624	Black Braided Silk	000	T-2

Package of 12 tubes of a kind $4 20

Plastic Sutures

FINE sizes of Kal-dermic, silk and silkworm gut with small, cutting point Atraumatic needles Suture length 18 inches. Boilable



NO	MATERIAL	SIZE	NEEDLE
1651	Kal-dermic	8-0	B-1
1651	Kal-dermic	6-0	B-1
1652	Kal-dermic	8 0	B-5
1652	Kal-dermic	6-0	B-5
1652	Kal-dermic	4-0	B-5
1653	Black Silkworm	4-0	B-1
1655	Kal-dermic	4-0	B-2
1658	Black Silk	4-0	B-2

Package of 12 tubes of a kind $4 20

Other D&G Sutures

SPECIAL needled sutures are also prepared for dental, tonsil, circumcision, obstetrical, ureteral, renal, nerve, artery, and emergency work These are in addition to our complete line of unneedled sutures embracing catgut, ribbon gut, kangaroo tendons, and a variety of other non-absorbable materials

DISCOUNTS ON QUANTITIES

DAVIS & GECK, INC , 217 DUFFIELD STREET, BROOKLYN, NEW YORK

Copyright 1938 Davis & Geck, Inc Printed in U S A

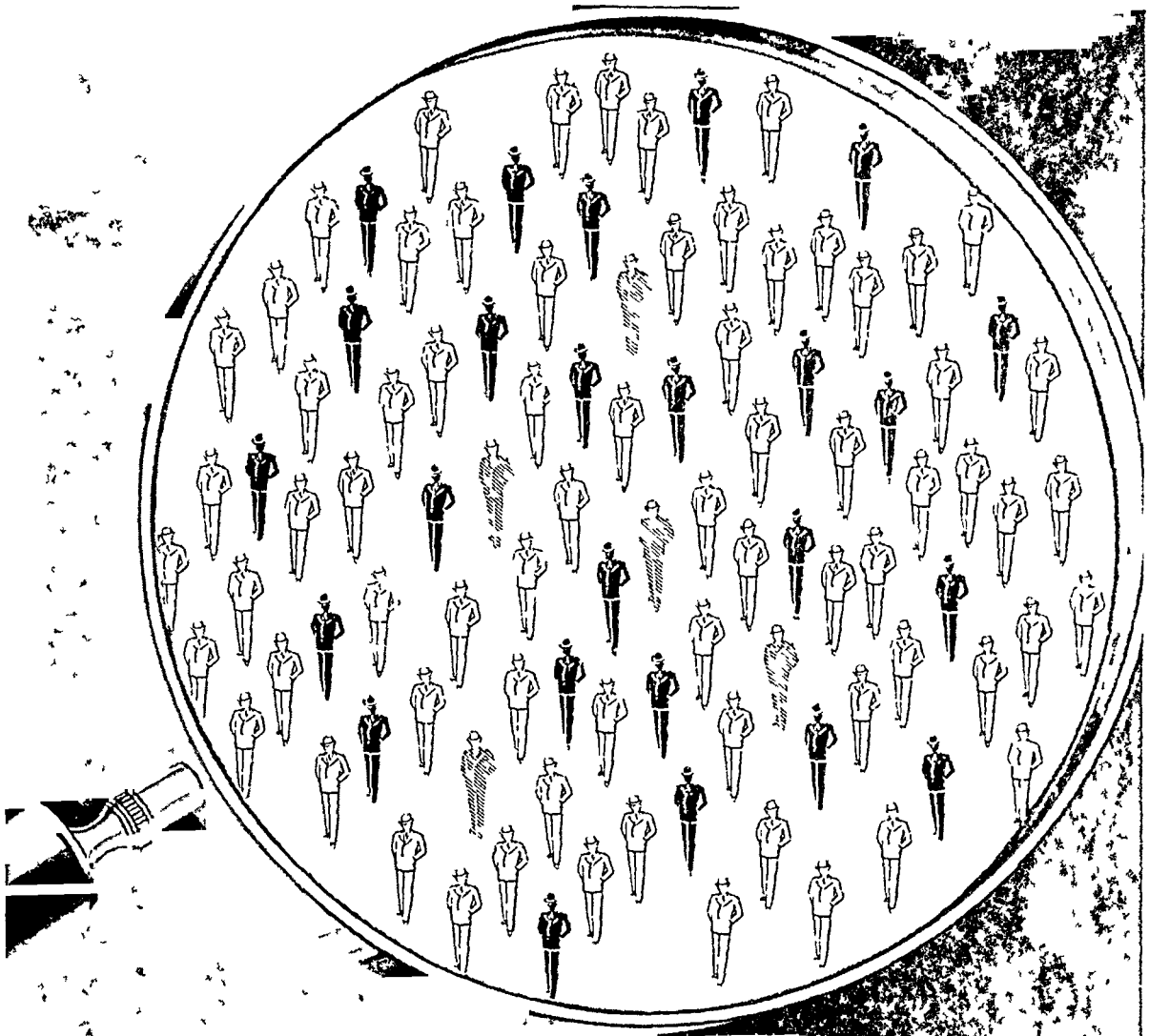


JOHN HUNTER (1728-1793) obtained much of the experience on which his "A Treatise on Blood Inflammation and Gunshot Wounds" was based while serving as staff naval surgeon during the war with France. In 1776 he was appointed Surgeon Extraordinary to the King and in 1785 performed his first ligation of the femoral artery in Hunter's Canal for popliteal aneurism. The old operation had proved unsatisfactory and this improvement of Hunter's was a significant contribution to surgery.

D&G Sutures

"THEY ARE HEAT STERILIZED"

DAVIS & GECK INC



Those 25 Patients who can be saved

Of one hundred cases developing type I pneumonia, seventy will recover and five will die regardless of treatment The remaining twenty-five will die without treatment, but can be saved by prompt administration of Antipneumococcic Serum, Felton

Reports in recent medical literature have shown that the very early use of specific [illegible] is important. In a series of 160 type [illegible] (R L Cecil J A M A [illegible] which specific antiserum [illegible] twenty-four hours of [illegible] reduced to one-third [illegible] serum-treated cases, and to [illegible] average rate in cases [illegible]

Antipneumococcic Serum (Felton) Type I, Refined and Concentrated, is available in syringe packages containing 10,000 and 20,000 units, Antipneumococcic Serum (Felton) Types I and II, Refined and Concentrated, in syringe packages containing, respectively, 10,000 and 20,000 units of each type

PARKE, DAVIS & COMPANY · *Detroit,* [illegible]

***THE WORLD'S LARGEST MAKERS OF PHARMACEUTICAL AND BIOLOGICAL* [illegible]**

Actual Practice in Surgical Technique



Method of Holding Connel Stitch From Principles of Operative Surgery, by A V Partipilo, M D

Special Courses—

Urology Cystoscopy Orthopedic Surgery Thoracic Surgery Surgical Pathology Laboratory Diagnosis and Technique Bronchoscopy Eye, Ear, Nose, and Throat Goiter Surgery Gynecology Surgical Anatomy Proctology

Visitors always welcome

CHICAGO POST-GRADUATE SCHOOL OF SURGERY

(Formerly—Laboratory of Surgical Technique)

(Incorporated not for profit)

Near Cook County Hospital

1 Two Weeks Surgical Technique Course rotary course continued throughout the year Combines Clinical Teaching and ACTUAL PRACTICE BY THE STUDENTS under competent supervision A review of the necessary Surgical Anatomy is embraced in the work

2 General Surgery One to Three Months Course designed for students who wish to review more thoroughly Anatomy, Surgical Pathology, Surgical Technique, and Clinical Surgery

3 Special instruction and practice in the technique of one or more operations is available to surgeons who wish to review the Anatomy and Technique of certain operations

Personal Instruction Actual Practice Operating Rooms, Equipment and Method of Teaching Ideal and Unsurpassed For information as to Courses, Fees, Registration Requirements, Etc, address

A V PARTIPILO, M D, F A C S, Director, 1950 S Ogden Ave, Chicago, Ill, Phone Haymarket 7044

Lowsley & Kirwin—UROLOGY FOR NURSES

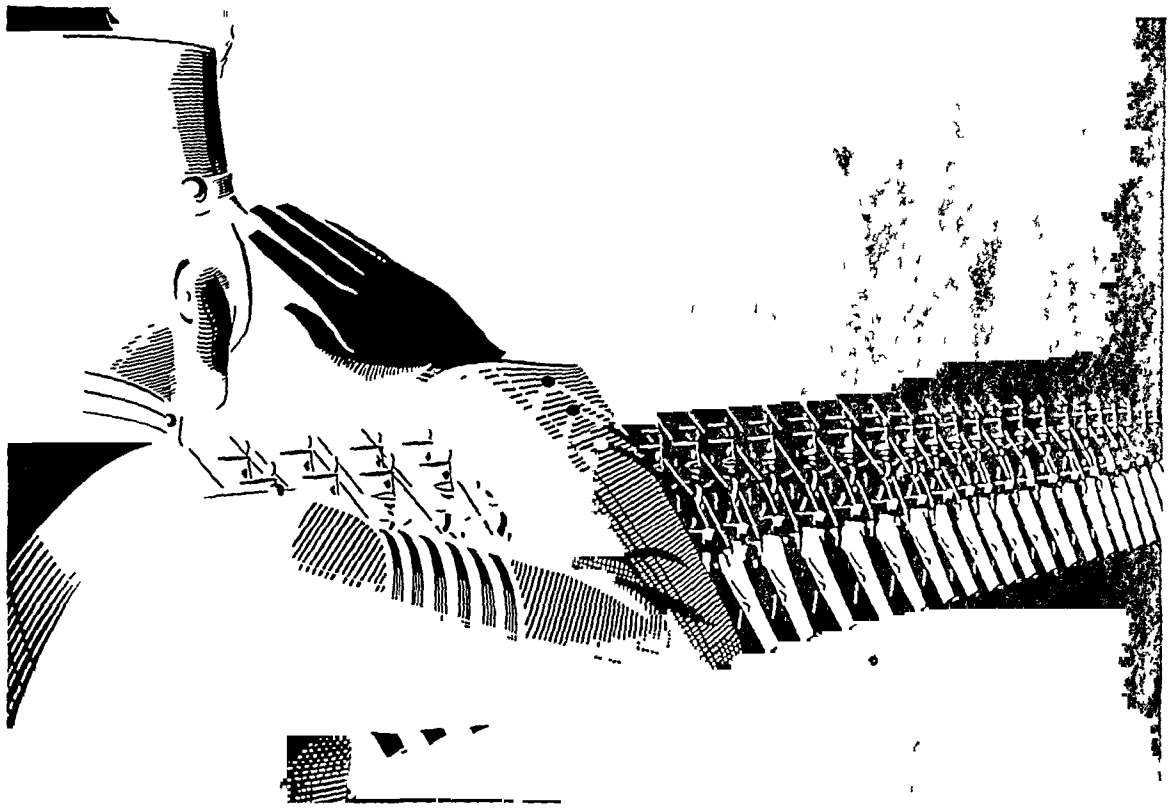
This new book adequately answers the urgent demand for a text in Urology which not only covers the basic science but also stresses the newer refinements of practice as well as presenting the Nursing factors in proper detail The methods are based on more than fifteen years of experience in a large, modern urological clinic through which thousands of patients pass annually Every instrument and method here described has been put to the severest test of actual usage The material is readily accessible to the teaching nurse, student and busy graduate It has a chapter on special instruments and equipment, instructions regarding their care Special emphasis is placed upon the part of the nurse in pre-operative and post-operative care, which, in such procedures as prostatectomy, is often as important as the operation itself The nurse's work in the operating and cystoscopic room in the preparation, assistance and care of the instruments after use is described in detail It has a chapter on diet and glossary

Octavo 493 pages 101 illustrations Cloth, $3 00

By OSWALD SWINNEY LOWSLEY, M D, Director, Department of Urology (James Buchanan Brady Foundation), New York Hospital, and THOMAS JOSEPH KIRWIN, M D, Attending Surgeon, Department of Urology (James Buchanan Brady Foundation), New York Hospital

J. B. LIPPINCOTT COMPANY

Dept AS Washington Square Philadelphia



DISCIPLINE

Discipline is the development of the faculties by instruction and exercise" When functions such as habit time of bowel movement are neglected through lack of discipline or intelligence, they require careful training to restore them to a normal state

Petrolagar has proved to be an agreeable and effective means of assisting in the establishment of bowel discipline Because Petrolagar mixes intimately with the bowel contents, it increases the bulk in the stool to a soft mass which is easily passed

Petrolagar is prepared in five types — providing the doctor with a variation of treatment to suit the individual patient Petrolagar Laboratories, Inc., Chicago, Ill

Petrolagar is a mechanical emulsion of pure liquid petrolatum (65% by volume) and agar agar Accepted by the Council on Pharmacy and Chemistry of the American Medical Association for the treatment of constipation

Petrolagar

Please mention ANNALS OF SURGERY when writing advertisers





IN TUNE *with* MODERN THERAPY

☆

*SYNTROPAN 'ROCHE'

A new non narcotic synthetic substance which has a definite antispasmodic action on spastic smooth muscle Try Syntropan, in place of atropine or belladonna,

TO CONTROL MUSCULAR SPASM

PACKAGES and DOSE For oral administration tablet, 50 mg , filled in tubes of 20 One tablet (50 mg) 3 or 4 times a day or as required For parenteral administration (sub cutaneous or intramuscular injection) ampuls 1 cc each containing 10 mg One ampul 3 times a day or as required

*The phosphate salt of 3 diethyl amino-2 2 dimethyl propanol ester of tropic acid.

HOFFMANN-LA ROCHE INC NUTLEY N J



PROGRESS in the therapeutic field is the aim of the Lilly Research Laboratories Research accomplishes this progress Confidence on the part of the medical profession should be reserved for medicinal products which are supported by adequate laboratory and clinical research ✓ Look for the Lilly trade-mark



FOR SPINAL ANESTHESIA

Ampoules 'Metycaine' (Gamma-[2-methyl-piperidino]-propyl Benzoate Hydrochloride, Lilly) 10 percent, 2 cc , give prompt, sustained anesthesia

FOR REGIONAL NERVE BLOCK

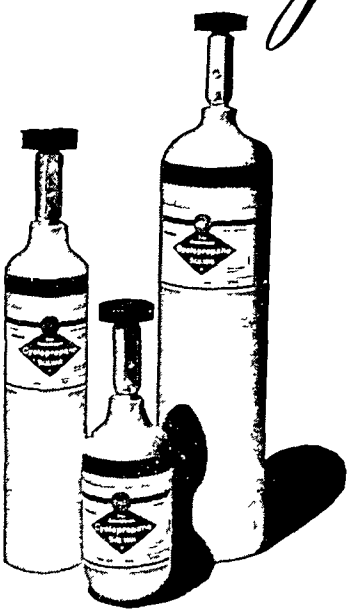
Ampoules 'Metycaine' 20 percent, 5 cc , are supplied (To be diluted before using)

Literature will be supplied to physicians upon request

ELI LILLY AND COMPANY

INDIANAPOLIS, INDIANA, U S A

CHARACTERIZED BY THE *highest degree* OF PURITY



CONTROL of the production of Squibb Cyclopropane begins with the selection and testing of the raw materials used, to make certain that they measure up to Squibb standards

Elaborate purification methods are used in the process of manufacture to render the gas free from deleterious substances A careful chemical analysis is made before the gas is released for sale

This extreme care in production results in an exceptionally pure gas Squibb Cyclopropane has been generally accepted by anesthetists throughout the country as a dependable anesthetic agent

Squibb Cyclopropane is supplied in 30-, 75-, and 200-gallon cylinders and in 2-, 6-, and 25-gallon Amplons * The 30-gallon cylinders and the 2- and 6-gallon Amplons are especially suitable for portable machines

NOTE Because of the great potency of Cyclopropane in low concentrations it is important that the anesthetist be thoroughly familiar with the technique of administration

*Amplon is a trade mark of E R Squibb & Sons

For information and booklet on Cyclopropane address Anesthetic Division, 745 Fifth Ave, New York, N. Y.

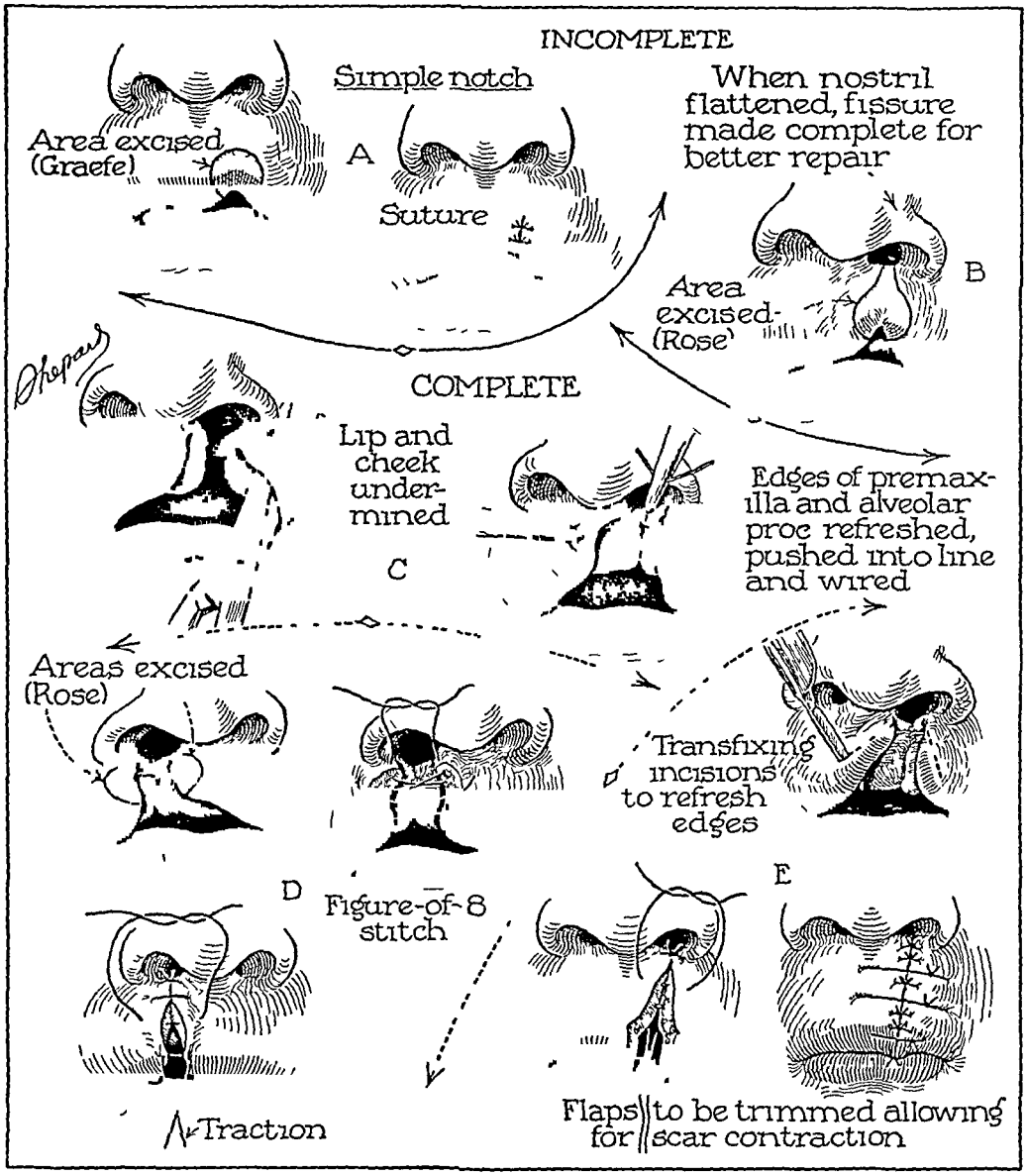
E·R·SQUIBB & SONS, NEW YORK

MANUFACTURING CHEMISTS TO THE MEDICAL PROFESSION SINCE 1858

OPERATIVE PROCEDURE

PLATE NO 78

Operations for Harelip—Single Cleft



Absolute sterilization by heat, without impairment of tensile strength, is the daily production standard of Ethicon Sutures As taken from the sterile tubes, they possess more tensile strength than is required to ligate the largest human blood vessel or to suture the densest human tissue Ethicon Sutures are produced by exclusive procedures, from the raw material to the final stage of packaging and inspection in our laboratories They are supple, smooth and uniform

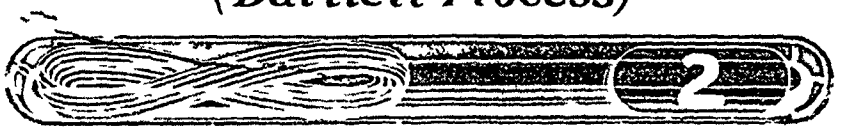
ETHICON NON-BOILABLE CATGUT SUTURES

JOHNSON & JOHNSON, NEW BRUNSWICK, N J , CHICAGO, ILL.
MANUFACTURERS OF SURGICAL SUTURES SINCE 1887

Please mention ANNALS OF SURGERY when writing advertisers

Lukens Sterile Catgut

TRADE (Bartlett Process) MARK



Make the Test Yourself

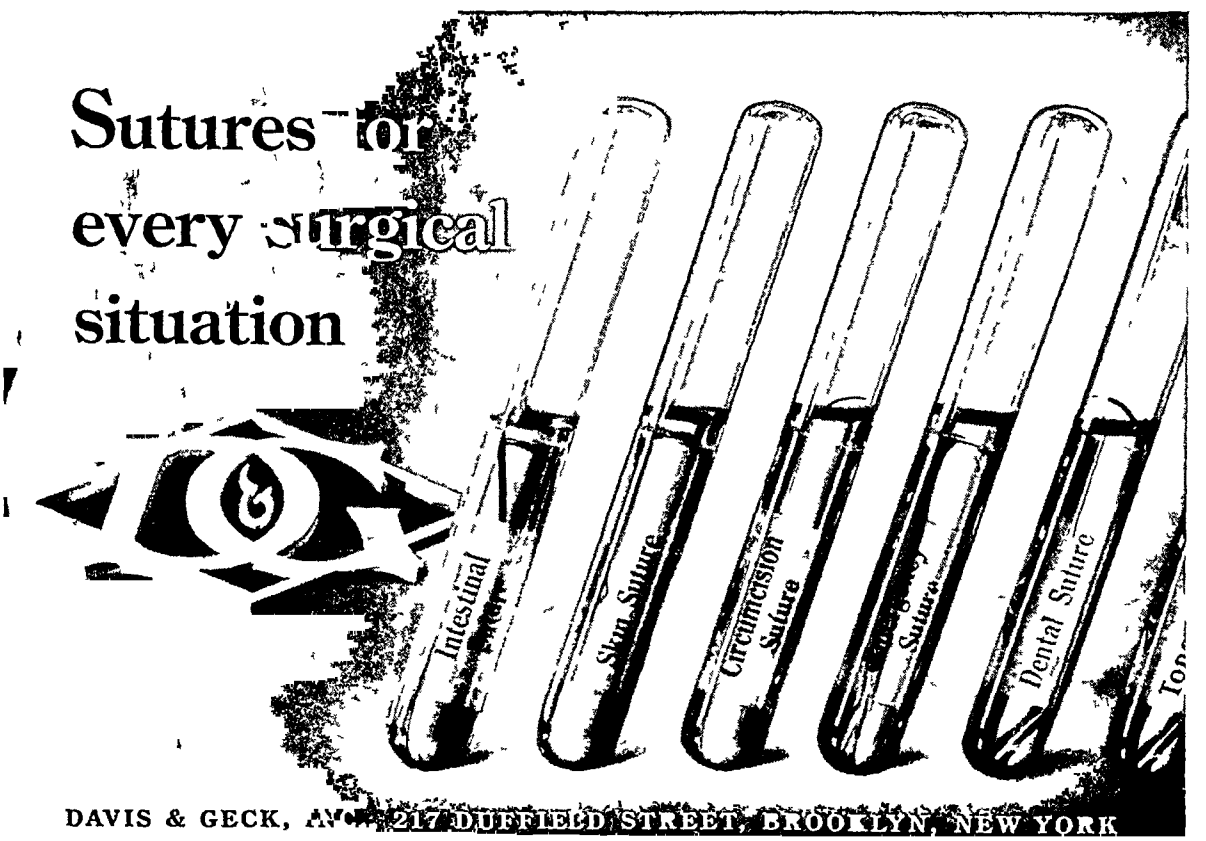
Compare It Point for Point With any Other Catgut

We Will Send the Samples

Sizes 00-4 Plain — Sizes 00-4 Tanned

C. DE WITT LUKENS CO.
4908 Laclede Ave.
ST. LOUIS, MO., U.S.A.

Sutures for every surgical situation



DAVIS & GECK, Inc. 217 DUFFIELD STREET, BROOKLYN, NEW YORK

ANNALS OF SURGERY

VOL 107 FEBRUARY, 1938 No 2

ACUTE INTESTINAL OBSTRUCTION

EVALUATION OF RESULTS IN TWENTY-ONE HUNDRED FIFTY CASES, WITH DETAILED STUDIES OF TWENTY-FIVE SHOWING POTASSIUM AS A TOXIC FACTOR

JOHN SCUDDER, M D , RAYMUND L ZWEMER, PH D ,
AND ALLEN O WHIPPLE, M D

NEW YORK, N Y

FROM THE DEPARTMENT OF SURGERY SCUDDER MEMORIAL HOSPITAL RANIPET, INDIA, AND THE DEPARTMENTS OF SURGERY, SURGICAL PATHOLOGY AND ANATOMY OF COLUMBIA UNIVERSITY COLLEGE OF PHYSICIANS AND SURGEONS, AND OF THE PRESBYTERIAN HOSPITAL NEW YORK, N Y

IN THE Orient, the problem of the neglected case of acute intestinal obstruction is difficult and the mortality high Even in the United States, despite advances in surgery and a clearer knowledge of many of the altered biochemical reactions, the death rate during the last 15 years has varied little (10 1 to 11 1 per 100,000), but the total number is constantly increasing [84a]

Mortality rates from as high as 61 per cent[84] to as low as 19 per cent[52] indicate what little uniformity exists regarding treatment and operative procedure In comparing the results obtained for similar lesions at different hospitals, this disparity becomes especially apparent For these reasons, Lincoln Davis[98] objected to the evaluation of statistics from various institutions unless they could be compared case by case

Since the observations of Leichtenstern[64] and Nothnagel,[89] the pulse rate has been used as a criterion in prognosis In Miller's[84] series, 71 per cent of the fatal cases exhibited either a subnormal temperature, or one above 100° F A rapid, shallow respiration was stressed by Braun and Boruttau[9] as an ominous sign in obstruction

In the neglected case, the quick pulse, the rapid respiration and the elevated or subnormal temperature contrast strongly with the normal values found in the early one In order to test whether a combination of these three variables would give a truer picture of the patient's condition, and thus afford a measure whereby the relative toxic state of each might be gauged, an index combining them was derived and applied in 570 cases of acute intestinal obstruction [106]

Determination of the Index —The index is the product of the three variables Temperature, pulse, and respiration The normals taken are Temperature, 98 6° F , pulse, 72, respiration, 16 To each, an arbitrary value of one is given

Temperature Factor	For each rise or fall of one degree Fahrenheit, one is added to the normal of one
Pulse Factor	For every rise of ten in the pulse rate, one is added to the normal of one

Respiratory Factor For each rise of five in the respiratory rate, one is added to the normal of one

Example A strangulated hernia of three days' duration was admitted with Temperature, 99 6° F , pulse, 112, respiration, 26 Index in this case 2 x 5 x 3 = 30 as compared with Normal Index 1 x 1 x 1 = 1

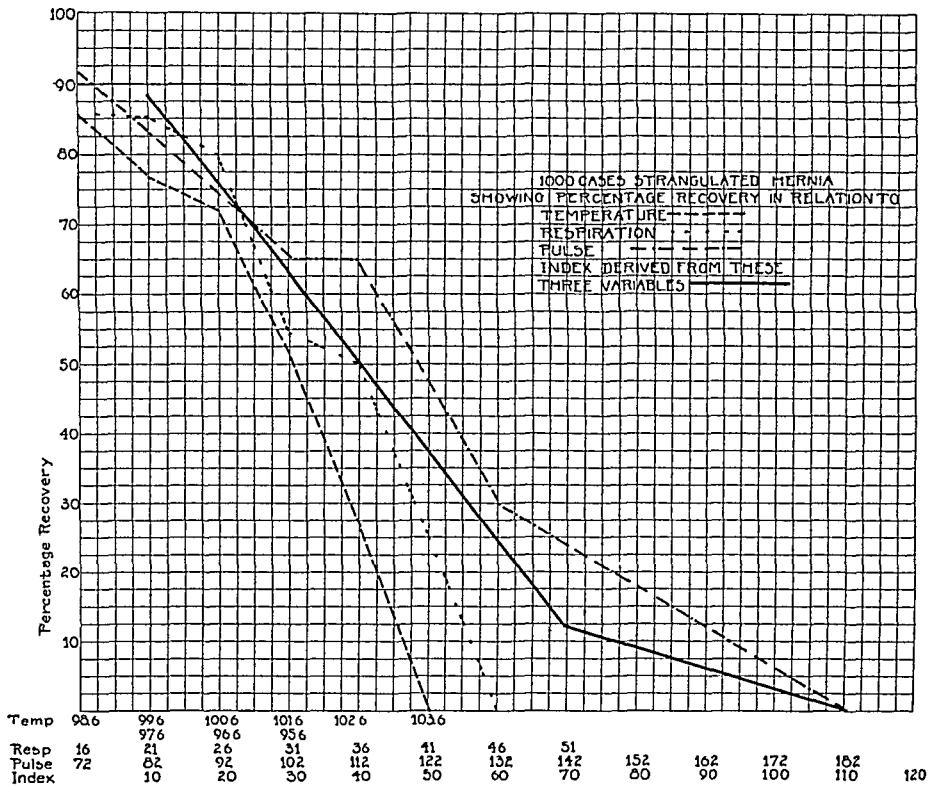


CHART 1 —Ordinates Temperature, pulse rate and respiration, index Abscissas Percentage of recovery

TABLE I

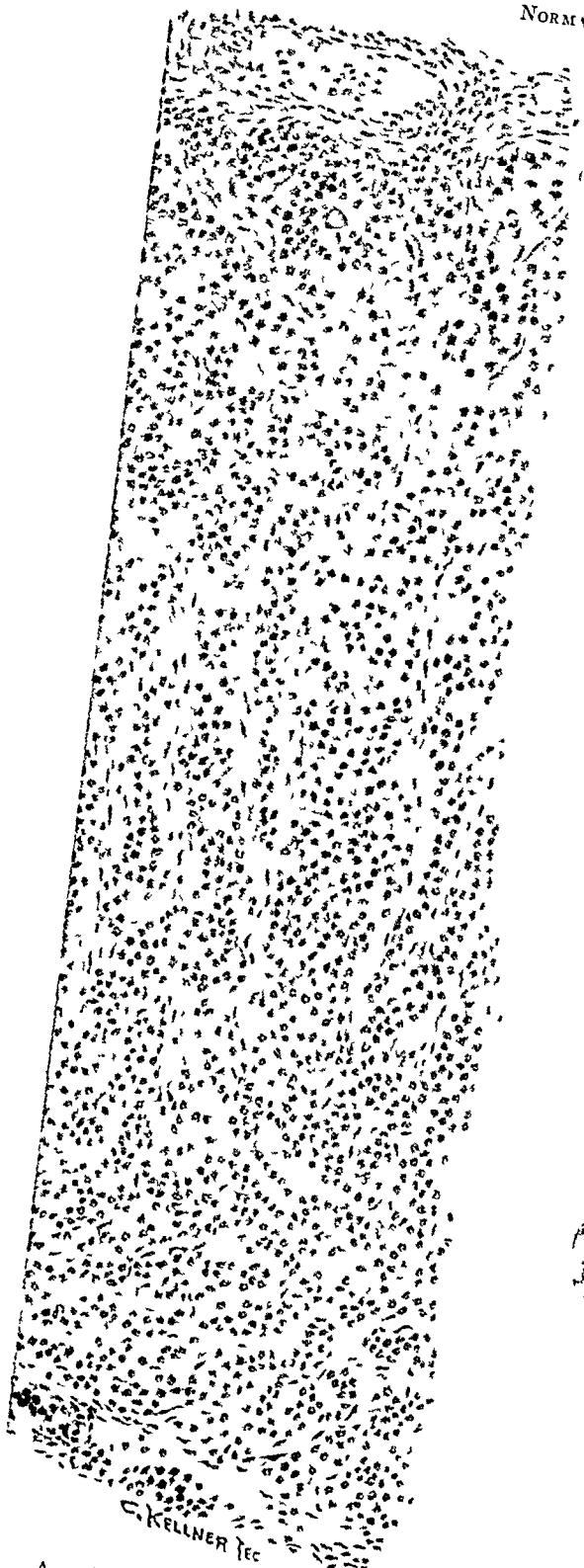
DETERMINATION OF FACTORS

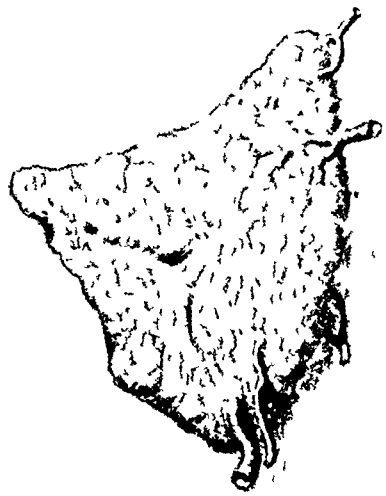
Temperature Factor	Pulse Factor	Respiration Factor
98 6° = 1	72 = 1	16 = 1
97 6° – 99 6° = 2	82 = 2	21 = 2
96 6° – 100 6° = 3	92 = 3	26 = 3
95 6° – 101 6° = 4	102 = 4	31 = 4
102 6° = 5	112 = 5	36 = 5
103 6° = 6	122 = 6	41 = 6

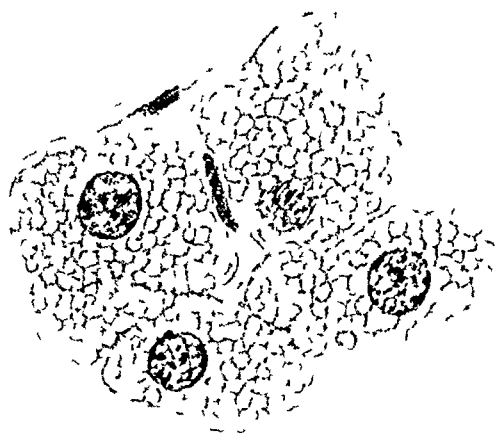
The indices of 1,150 cases of acute mechanical obstruction (Group I*) were determined and charted, with the recovery rate plotted against the index The declivity of the line shows that survival stands in inverse proportion, and mortality in direct proportion to the magnitude of the index

PLATE I

NORMAL HUMAN ADRENAL CORTEX







A right adrenal gland of approximately normal size, shape and color showing the superior, middle and inferior arteries, the central vein and an alternate venous drainage (upper right) Camera lucida painting of a segment of a frozen section of adrenal cortex from the capsule (with capsular artery in cross section) to the juxtamedullary border The lipoids are stained orange red with Sudan III and the nuclei blue with Harris' hematoxylin The section was mounted in Zwemer's glycerogel $\times 120$ (left) A few lipoid rich gland cells from the outer fascicular zone of the above section A diminution of this type of cell is associated with a demand on the gland The nuclei of two capillary endothelial cells are also illustrated $\times 900$ (lower right)

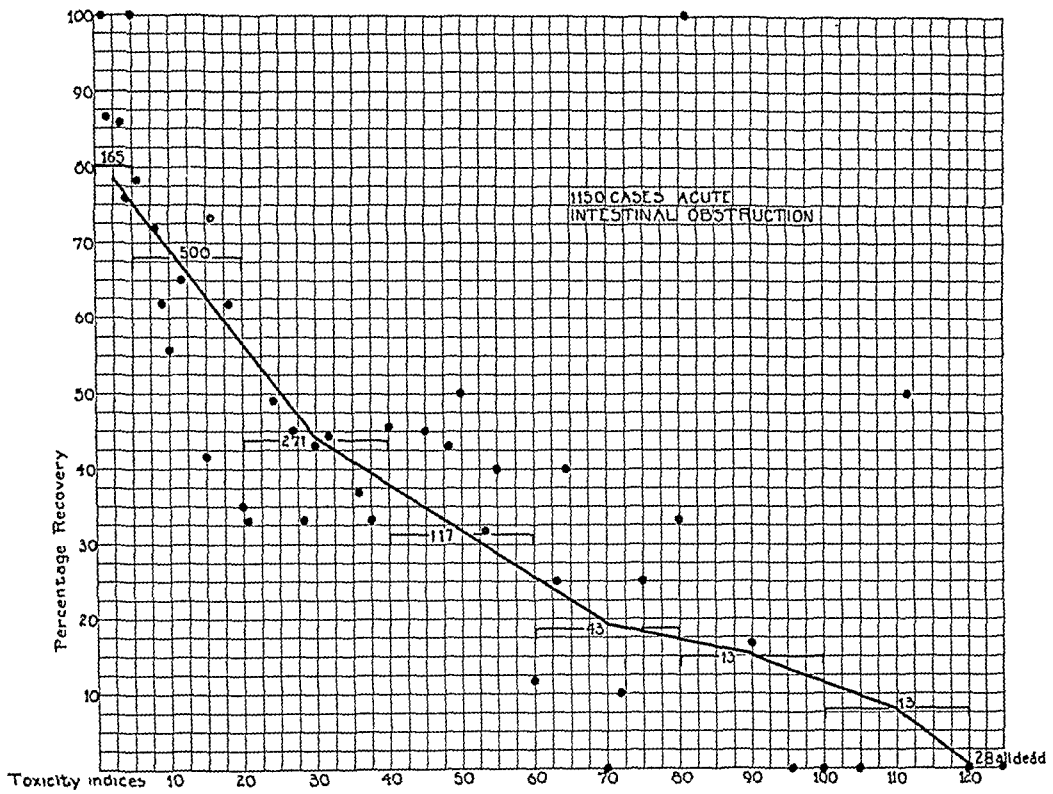


CHART 2.—Ordinates Toxicity index Abscissas Percentage of recovery Scatter diagram showing the percentage of recovery for each index Brackets indicate the number of cases and the range of indices taken for each point on the chart

This same correlation is seen in 1,000 cases of strangulated external hernia (Group III*) (Chart 3)

Analysis of the Results of Operative Procedures.—With the objective value of the index revealed in 2,150 cases† the types of surgical procedures were gauged in respect to the patient's condition

The reduction of a strangulated hernia with viable intestine gave the optimum prognosis in all cases The addition of an enterostomy raised the mortality In the gangrenous hernia, a resection with primary anastomosis augured better than did the principle of marsupialization (Chart 4)

In analyzing the 925 operations with viable intestine, the relief of obstruction, whether effected by division of the adhesions, detorsion of a volvulus, or reduction of an intussusception, offered the patient the best chance as judged by 76 per cent recovery in 520 cases, and a higher survival at each index up to 60 (Chart 5)

A primary enterostomy with the relief of obstruction raised the mortality rate in 149 cases Grouped as to indices, the recovery rate was lower in those

* Cases of obstruction are grouped according to the Massachusetts General Hospital plan Group I Acute mechanical obstruction, except those due to neoplasms Group II Obstruction due to neoplasms Group III Obstruction due to strangulated external hernia This paper does not include Group II, nor children under 12 years of age

† The statistical data were reviewed by Dr E B Wilson of the School of Public Health, Boston The scatter diagrams were made at his suggestion

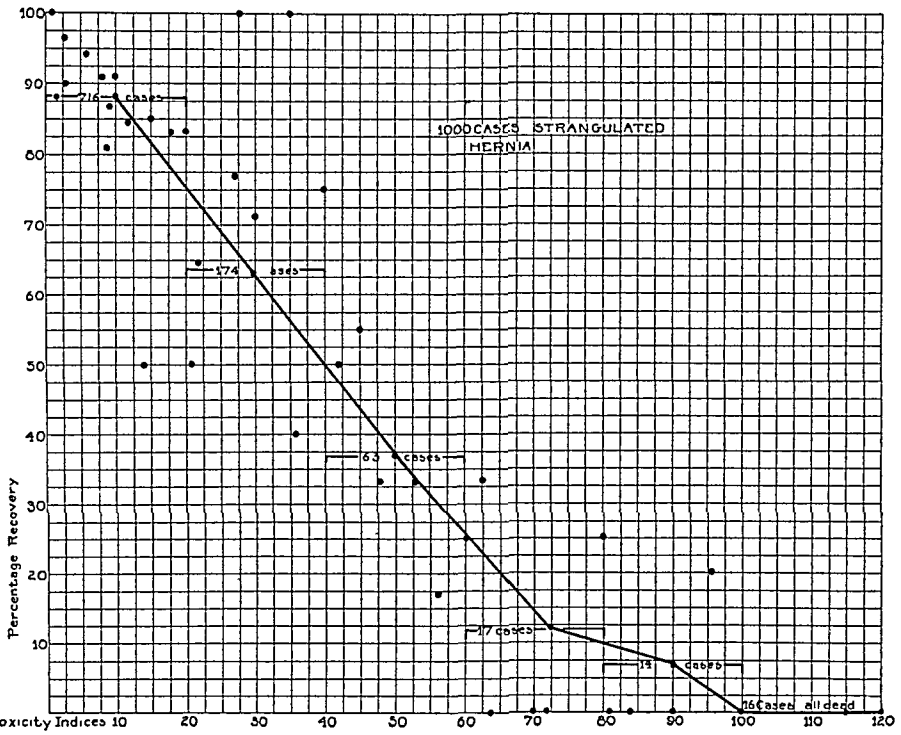


CHART 3.—Ordinates Toxicity index Abscissas Percentage of recovery Scatter diagram showing percentage of recovery for each index Brackets indicate the number of cases and the range of indices taken for each point on the chart

enterostomy cases below 60, and about the same for both the enterostomy and nonenterostomy groups above this index (22 and 19 per cent respectively)

Enterostomy or cecostomy *without* the removal of the lesion gave a 70 per cent mortality, a figure worse than that reported by Treves,[122] in 1884 A short-circuiting operation around the lesion failed to achieve the same success as did its removal

TABLE II

PERCENTAGE OF RECOVERY IN 2,150 CASES OF ACUTE INTESTINAL OBSTRUCTION, GROUPED ACCORDING TO ETIOLOGY (CHILDREN UNDER 12 EXCLUDED)

GROUP I (Massachusetts General Hospital Classification) Lesion	Lived	Died	Total	Recovery Per Cent
Bands and adhesions	360	213	573	63
Volvulus of small intestine	90	66	156	58
Volvulus of large intestine	70	57	127	55
Intussusception	38	31	69	55
Miscellaneous	18	18	36	50
Gallstones and foreign bodies	8	9	17	47
Meckel's diverticulum	6	9	15	40
Internal strangulated hernia	14	22	36	39
Cause not ascertained	24	62	86	28
Mesenteric thrombosis	4	31	35	11
Totals	632	518	1,150	55
GROUP II Obstruction due to tumors not included				
GROUP III Strangulated external hernia	765	235	1,000	76 5
Total of Series	1,397	753	2,150	65

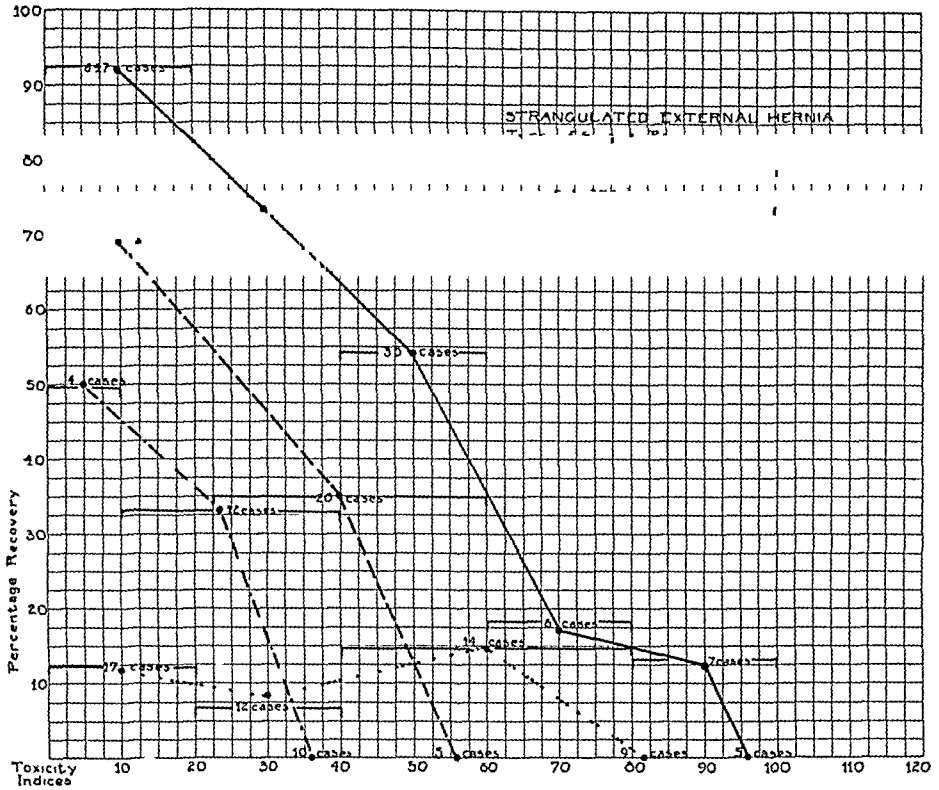


CHART 4.—Ordinates Toxicity index Abscissas Percentage of recovery Surgical procedures in 1 000 cases of strangulated hernia Brackets indicate the number of cases and the range of indices for each point on the chart

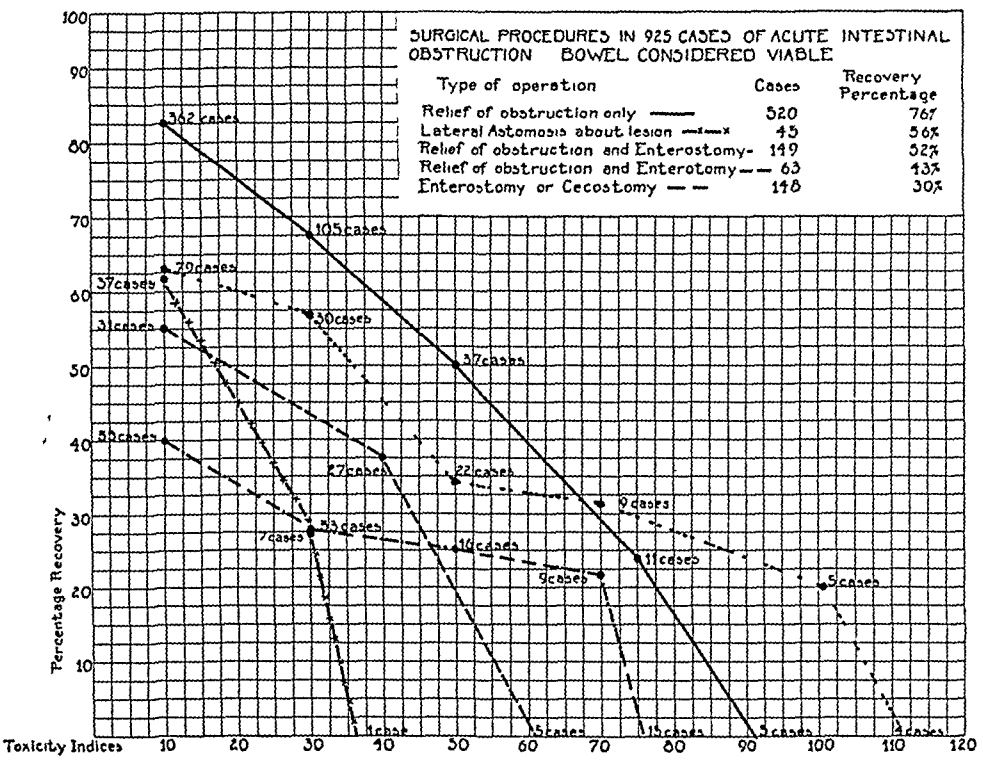


CHART 5.—Ordinates Toxicity index Abscissas Percentage of recovery Contrast of the recovery rate for different surgical procedures in 925 cases of obstruction The figures represent the number of cases For example there were 362 cases, whose indices ranged from one to 20, in which the obstruction was relieved The percentage of recovery for this group was 82 5 The next figure, 105, indicates that number of cases whose obstruction was relieved The indices for this group fell between 21 and 40 The percentage of recovery was 67 5 In the same range of indices there were 30 cases which had the obstruction relieved and a primary enterostomy, their percentage of recovery was 10 per cent less than the 105 cases who did not have a primary enterostomy with the relief of obstruction

In analyzing the 178 cases with gangrene of the intestine, a resection with a primary anastomosis in the mildly toxic case was preferable, whereas, in the severely ill patient, resection with delayed anastomosis gave better results Again, the exteriorization of the gangrenous bowel carried the greatest number of failures

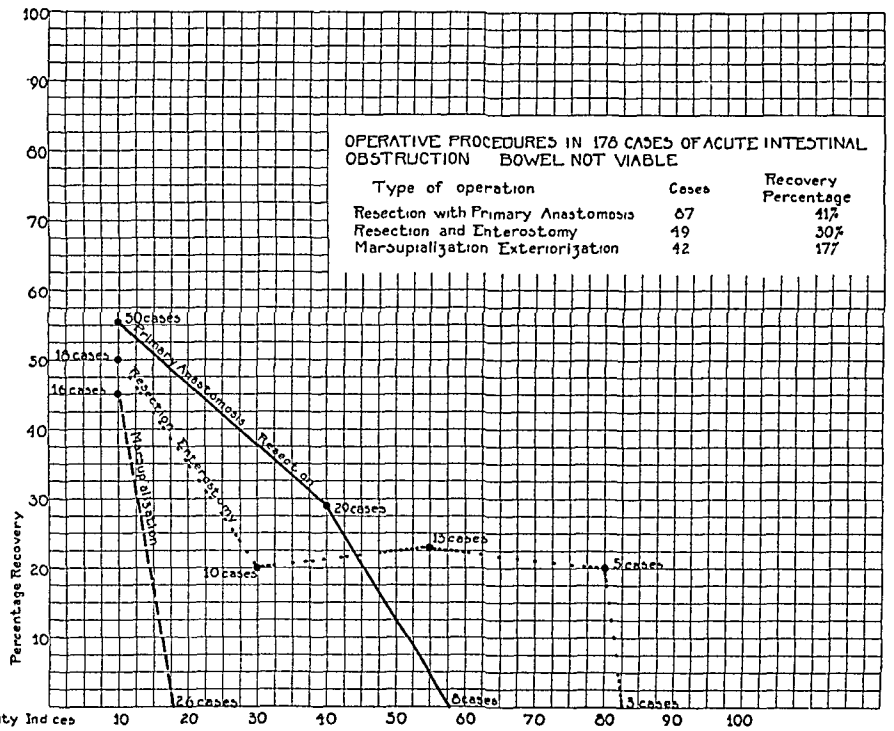


CHART 6.—Ordinates Toxicity index Abscissas Percentage of recovery Contrast of recovery rate for three different surgical procedures used in dealing with gangrenous intestine Marsupialization of the loop was not as successful as resection and enterostomy or resection with primary anastomosis

After summarizing these cases, we are forced to again raise the following questions* What is the toxic depressor substance in acute intestinal obstruction? Why is strangulation or gangrene more rapidly fatal? In what manner does an enterostomy increase the mortality? Why is gastric lavage beneficial? Why is the slow pulse so often misleading? Finally, how does salt solution mitigate the toxemia of obstruction?

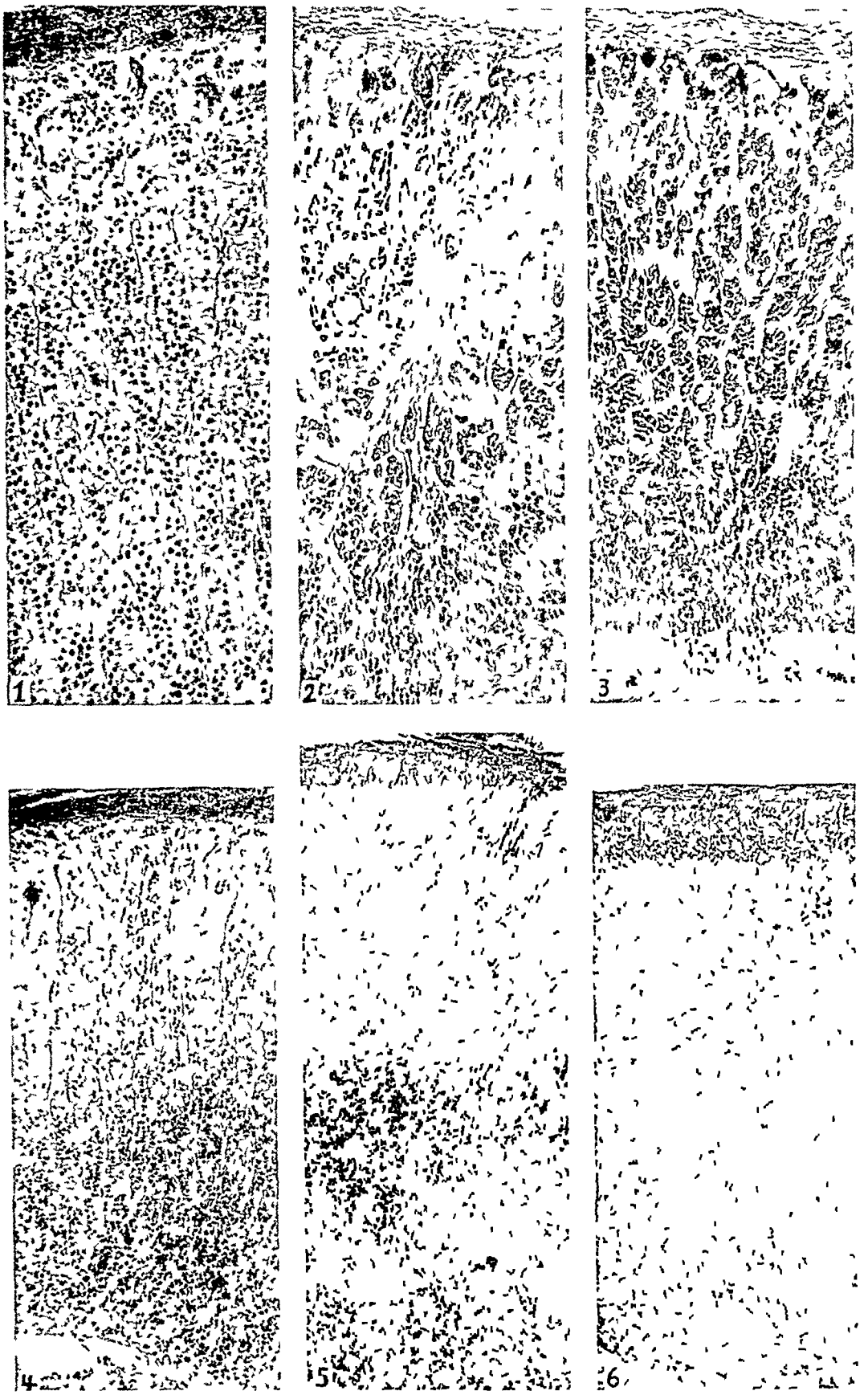
Our attention was directed to the adrenal glands by Wohl, Burns and Clark,[130] who reported cortical cell depletion in experimental obstruction un-

LEGEND FOR PLATE II.—Normal human adrenal cortex Segment of a median section Note large clear cells which contained lipoid (×100) *Nos 2 and 3.—Adrenal cortex sections (full width) from two* patients dying of intestinal obstruction Note disorganized cell arrangement and presence of connective tissue between cell columns It resembles Type 7 or 8 of Zwemer's[133] classification Postmortem cell changes and shrinkage due perhaps to technic should be discounted (×100) No 4.—Same adrenal as No 1 at a lower magnification, to show cell types from capsule to medulla (×60) No 5.—Normal cat adrenal cortex The relative thickness of rounded adrenals is greater than that of the folded primate type (×60) *No 6.*—Adrenal cortex from Cat No 3636 showing absence of lipoid loaded "spongiocytes" This animal died three and one half days after esophageal obstruction (×60)

*A more complete discussion and bibliography is given by Cooper, H S F Cause of Death in High Obstruction Arch Surg, 17, 918–967, 1928, and by McIver, M A Acute Intestinal Obstruction New York, Paul B Hoeber, Inc, 1934

PLATE II

PHOTOMICROGRAPHS ILLUSTRATING VARIOUS PHASES OF ADRENAL HISTOPATHOLOGY



See opposite page for legend

treated by saline solutions Examination of sections secured from autopsy cases at the Peter Bent Brigham Hospital revealed various stages of cortico-adrenal depletion according to the classification of Zwemer [133]

Acute intestinal obstruction and adrenal insufficiency have many features in common With the latter a definite disturbance in potassium metabolism has been shown to exist [1, 7, 42, 49, 69, 137] In experimental obstruction in cats, we have reported a rise in blood potassium to lethal levels The potassium values for the contents of obstructed loops, peritoneal fluid and vomitus were many times that of blood [107] In experimental intestinal obstruction in dogs, Cutler and Pijoan[19] confirmed the occurrence of a hyperpotassemia

Coincident with the experimental work, studies were begun on patients We report here 25 cases, in 20, potassium determinations were made on blood secured at the time of admission, in two, the blood was taken after the administration of therapy, and in three, after operation

Methods —Unless otherwise stated, fasting blood was collected in the morning by the same person The sample was drawn with a sterile dry syringe from the antecubital vein without a tourniquet and placed into a Sanford-Magath hematocrit tube containing heparin After centrifuging at 3,000 r p m for one hour, the cell volume was read, and plasma separated immediately from the cells Samples showing any hemolysis were discarded The potassium content of 0 1 Ml of whole blood and 0 4 Ml of plasma was determined by the method of Truszkowski and Zwemer [123, 123a] The values given represent the average of two determinations, differing by not more than ± 2 per cent from the mean

The specific gravity of whole blood and plasma was measured by the falling drop* method of Barbour and Hamilton [6] Plasma protein was calculated by the formula of Weech, Reeves and Goettsch [127]

The following figures are given as normal for potassium in the blood of humans Whole blood, 164 to 200 mg per cent, serum potassium, 18 to 21 mg per cent, cells, 350 to 465 mg per cent, average, 418 mg per cent Because of the wide normal range, emphasis should be placed on the change in potassium level rather than in absolute values [56, 57, 74, 88]

Summary of the Potassium Content Data —*Plasma Potassium* In the 20 untreated patients, whose blood was taken on admission, the plasma potassium was raised in seven (Cases 1, 2, 3, 4, 9, 19, 20) and low in five (Cases 5, 8, 14, 16, 18), the highest value being 33 4 mg per cent (Case 9) and the lowest 13 4 mg per cent (Case 5) In Case 23, a plasma potassium value of 28 2 mg per cent was found after 300 cc of 5 per cent salt solution Plasma K decreased in 12 following administration of saline and other treatment [120] In two (Cases 14 and 22), despite saline, there was an increase in the plasma value Both cases showed extention of the gangrenous process at autopsy

Case Report —Case 20 Bronchopneumonia complicated by a strangulated femoral hernia [56] Plasma potassium was high, rising to 30 1 mg per cent following operation,

* Pipettes may be obtained from Eimer & Amend, New York

decreasing after the administration of eschatin† and salt solution but again climbing to 32 3 mg per cent in spite of further therapy Elimination by kidneys poor as indicated by oliguria and a rise in the N P N The K in the urine, however, was 450 mg per cent Profuse sweating and muscular twitchings were prominent features [108]

Cell Potassium —In 20 untreated cases the average cell potassium was 359 with a range of 302 to 438 mg per cent In 14 of these, cell K was distinctly low Treated by injections of salt solutions, cell potassium rose in 12 (Cases 3–9, 11, 13, 14, 15, 18), and fluctuated in Cases 10, 13, 16, 19 and 20 In other conditions the importance of cell K changes has been stressed [51 88a]

Whole Blood Potassium on admission was above normal in five (Cases 5, 6, 7, 12, 13), and low in Case 20

Peritoneal Fluid Potassium varied from 13 2 to 28 6 mg per cent in 11 cases

Spinal Fluid Potassium was lower than the plasma potassium when they were taken simultaneously in Cases 11 and 12 [27]

Potassium Content of Gangrenous Loop Fluid —The values ranged from 109 to 637 mg per cent in four cases (Cases 5, 14, 20, and 22) Death occurred in all

Potassium Content of Enterostomy Fluid —Analysis of potassium in both plasma and enterostomy fluid in Case 9 showed the results to be identical [20 128] In Case 25, the intestinal fluid K was twice that of plasma

Potassium Content of Gastric Fluid —In eight cases (Cases 14, 16, 18, 19, 20, 22, 24 and 25) determinations of potassium in both plasma and gastric contents showed a range in the latter from 18 5 to 65 8 mg per cent, the average concentration of the gastric juice potassium being 2 5 times that of blood taken simultaneously [54, 107]

Plasma Specific Gravity —The average in 18 cases was 1 0297 with a range from 1 0264 to 1 0379 This contrasts with the average normal plasma density of 1 0260 to 1 0270

Hematocrit —This showed 48 2 per cent cells in the 20 untreated cases with a range from 33 to 59 per cent This average of 48 2 per cent contrasts with the normal figure of 45 per cent

Plasma Protein —In the untreated cases the average plasma protein was 7 8 Gm per cent with a range from 6 6 to 10 6 Gm per cent This is higher than the average normal of 7 0 Gm per cent

Discussion —Certain phenomena associated with acute intestinal obstruction may be partly explained by considering potassium in their interpretation

Simple Obstruction —In the progressive dehydration accompanying this lesion, a lethal rise in blood potassium has been demonstrated experimentally, the rapidity depending upon the site of obstruction [107]

Intestinal Strangulation and Gangrene —Interference with the vascular supply of the intestines is always associated with a higher mortality In our experimental work, we attribute the earlier development of toxemia to a more rapid and sustained rise in blood potassium, occasioned by a loss of fluids,

† Eschatin has been furnished by the kindness of Parke, Davis & Company

SYNOPSIS OF THE DATA IN 25 CASES OF ACUTE INTESTINAL OBSTRUCTION EXCLUDING THOSE DUE TO NEOPLASMS

Case Number	Hospital Number, Initials Age Sex	Type of Lesion Duration before Operation Date of Operation Anesthesia	Date and Time of Obtaining Blood	*Potassium in mg % in* Whole Blood	Cells	Plasma	Cell Volume by Hematocrit	Plasma Specific Gravity	Plasma Protein	Other Data and Remarks	Result Date of Discharge
				Average Values for Ten Healthy Donors							
				190	376	16 7	46 1%	1 0261	6 5%		
1	85728 J E 59 yrs Female	Strangulated incisional hernia 5 days 9/29/36	9/24/36 2 P M	169	343	25 7	42 %			Ser chlorides 565 mg %, Bl CO_2 61 cc /100, B U N 13 mg /100 Intermittent type of obstruction Treated conservatively 5 days by colon lavages clyses of saline and glucose	
	Index 6	Repair of hernia G -O -E								Location of lesion Low ileum	Cured 10/24/36
2	448691 S L 60 yrs Male	Acute int obstr due to bands 2½ days 9/26/36	9/26/36 11 A M 10/17/36 7 30 A M	202 198	366 367	29 8 17 6	47 % 49 %			Case reported previously ref SURG 1 74 January 1937 Location of lesion Injected loop of lower ileum	
	Index 12	Jejunostomy Spinal 9/28/36 Division of bands Spinal									Cured 11/5/36
3	368800 R P 37 yrs Female	Acute int obstr due to peritoneal adhesions 2 days	11/14/36 2 P M	196	347	29 1	48 %	1 0287	7 4%	R B C 5 000 000, Hb 85%, W B C 17 400, P 89% Roentgen ray Multiple fluid levels Gastric and repeated colon lavages No improvement in 12 hrs Clysis 2 000 cc	
	Index 2	11/15/36 Division of bands Spinal	11/15/36 3 30 A M	180	364	23 0	43 %	1 0246	6 %	Taken after operation Peritoneal fluid was sanguineous	
			11/16/36 7 10 A M	196	390	24 0	44 %	1 0257	6 4%	*Potassium content of centrifuged specimen 21 3 mg %*	
			11/18/36 7 30 A M	157	366	21 5	37 %	1 0231	5 5%	Location of lesion Cyanotic loop of ileum	Cured 11/29/36
4	506308 A C 47 yrs Female	Acute int obstr due to strangulated ventral hernia 2 days 12/19/36	12/19/36 1 55 P M 12/20/36 10 30 A M	207 172	332 352	27 3 20 4	54 % 43 %	1 0299 1 0255	7 8% 6 3%	W B C 16 600, P 85%, Roentgen ray Fluid levels Urine Alb H T Glu 4+ Acetone 4+ Given 2 000 cc Ringer s solution by infusion at oper Peritoneal fluid sanguineous	
		Relief of obstruction Spinal	12/22/36 7 15 A M	154	375	18 9	36 %	1 0246	6 %	*Potassium content after centrifuging 21 3 mg %* 12/21/36 Bl urea N 21 mg /100 Bl sugar 144 mg /100 Bl sugar 153 mg /100	
			12/29/36 7 40 A M	174	356	20 9	43 %	1 0275	7 %	Location of lesion dusky loop of ileum in sac	Cured 1/30/37

5	506363 M W 53 yrs Female Index 100	Anemic infarct of terminal ileum and cecum due to mesenteric thrombosis 2 days 12/23/36 Resection of cecum and ileum Primary anastomosis Spinal	12/23/36 7 30 P M 10 P M 12/24/36 1 30 A M 8 A M	228 233 198 220	365 382 334 365	13 4 15 0 21 5 22 8	59 % 57 % 53 % 54 %	1 0276 1 0301 1 0259 1 0262	7 % 7 9% 6 5% 6 6%	On admission W B C 13 500, P 86% Given 1 500 cc of Ringer's solution This blood was taken before operation and after the saline had been given At the end of operation, during which time 2 000 cc of Ringer's solution intravenous Continuous infusion of Ringer's solution running when this sample was obtained	
						Serum		Serum	Serum		
			12/25/36 9 A M			21 5		1 0234	5 6%	*Potassium content in resected loop after centrifuging 591 6 mg %*	
			7 P M			20 2		1 0249	6 1%	Location of lesion Cecum and terminal ileum	
			12/26/36 9 A M			24 0		1 0237	5 7%	Autopsy Extension of mesenteric thrombosis up the ileum	Died 12/26/36
6	508585 V F 31 yrs Female Index 4	*Obstruction* due to multiple postoperative adhesions 1 day 1/16/37 Division of adhesions Spinal	1/16/37 3 P M 7 P M 1/17/37 8 A M	210 210 172	406 457 320	19 9 18 1 20 8	47 % 42 % 46 %	1 0303 1 0267 1 0229	8 % 6 7% 5 4%	On admission W B C 12 120, P 95%, Hb 105 Roentgen ray Fluid levels in ileum Given hyperdermoclysis This blood taken on operating table after spinal anesthesia and ephedrine had been given *Peritoneal fluid K 18 4 mg % uncentrifuged* *17 5 mg % centrifuged*	
			1/18/37 8 A M	163	388	19 6	37 %	1 0235	5 7%	Location of lesion Lower ileum	Cured 2/1/37
7	508670 G L 70 yrs Male Index 24	Obstruction due to strangulated inguinal hernia Richter's hernia of transverse colon 1 day 1/21/37 Relief of obstruction Spinal	1/20/37 9 P M 1/21/37 2 A M 7 30 A M	210 192 184	352 332 340	19 7 19 6 17 5	54 % 52 % 49 %	1 0272 1 0264 1 0261	6 9% 6 6% 6 5%	W B C 14 600, P 94% Roentgen ray Fluid levels Barium enema showed obstruction in transverse colon Taken during operation but before 3 000 cc of Ringer's solution had been given by infusion and clysis Taken before clysis of 2 000 cc of saline and glucose	
			1/22/37 7 30 A M	170	318	20 4	47 %	1 0242	5 9%	Taken before clysis of 1,500 cc of saline and 5% glucose	
			2/3/37 7 30 A M	178	318	18 4	50 %	1 0275	7 %	Location of lesion Transverse colon	Cured 2/6/37

(*Continued on next page*)

SYNOPSIS OF DATA (*continued*)

Case Number	Hospital Number, Initials Age, Sex	Type of Lesion Duration before Operation Date of Operation Anesthesia	Date and Time of Obtaining Blood	*Potassium in mg % in* Whole Blood	Cells	Plasma	Cell Volume by Hematocrit	Plasma Specific Gravity	Plasma Protein	Other Data and Remarks	Result Date of Discharge
8	509097 W C H 34 yrs Male	Obstruction due to multiple postoperative adhesions 2 days	2/8/37 1 30 P M	180	350	15 2	47 %	1 0304	8 %	W B C 15 200, P 88%	
			6 55 P M	180	374	15 4	44 %	1 0289	7 5%	Taken after operation and before infusion of Ringer s solution	
	Index 18	2/8/37 Division of peritoneal bands Spinal	8 P M	150	320	12 9	43 %	1 0258	6 4%	Taken after infusion	
			2/17/37 7 30 A M	137	335	19 8	35 %	1 0262	6 6%	Location of lesion Lower ileum	Cured 2/23/37
9	419165 L P Negro 29 yrs Male	Obstruction due to band Had been operated on for acute appendicitis with peritonitis 2½ yrs previously	2/17/37 4 45 P M	195	306	33 4	53 %	1 0379	10 6%	N P N 55 mg %, W B C 18 700, P 88% Roentgen ray Fluid levels in ileum ' B P 140/110	
			9 40 P M	201	334	23 7	53 %	1 0379	10 6%	Taken on operating table after spinal and ephedrine had been given and after incision	
	Index 12	4 days	10 40 P M	183	330	18 3	50 %	1 0341	9 3%	Taken at the end of operation and after the administration of 1 500 cc of Ringer s solution by infusion	
		2/17/37 Division of band Enterostomy Spinal G–O–E	2/18/37 8 10 A M	182	354	15 8	47 %	1 0238	5 8%	*Peritoneal fluid cloudy Potassium content 15 9 mg %* Continuous infusion running when blood was taken Serum chlorides 585 mg % Bl urea N 23 mg %	
			2/19/37 7 30 A M	179	342	21 2	46 %	1 0283	7 3%	Continuous infusion running Gastric suction stopped today Enterostomy draining *Potassium of enterostomy fluid 21 2 mg %* R B C 4 000 000, Hb 85%	
			2/20/37 7 30 A M	195	386	17 6	46 %	1 0258	6 4%	*Potassium of enterostomy fluid 18 0 mg %*	
			2/24/37 7 30 A M	177	359	22 7	43 %	1 0264	6 6%	Ser chlorides 515 mg %, CO_2 56 Ml /100 cc Enterostomy tube still draining	
			3/6/37 7 30 A M	176	382	16 0	42 %	1 0242	5 9%	Wounds practically healed Up in chair Location of lesion Lower ileum	Cured 3/12/37
10	258815 G L 35 yrs Negress	Obstruction due ' large inflamed sheath of tissue where the broad ligament had been united at a pre-	2/19/37 2 30 P M	163 4	438	19 1	33 %	1 0318	8 5%	R B C 4 120 000, Hb 70%, W B C 7 900, P 58%, N P N 28 7 mg %, ser chlorides 563 mg % Roentgen ray Gaseous distended loops of colon with multiple fluid levels	

10	258815 C L 35 yrs Negress	Obstruction due large inflamed nbr ith of tissue where the broad ligament had been united at a pre-	2/19/37 2 [illegible] M	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	Index 10	vious operation 27 days ago ' 2 days	2/20/37 7 30 A M	146	286	23 2	43 %	1 0267	6 7%	Colostomy has not been opened Patient very restless Pulse 160 temp 104° Has had 3 000 cc of saline and 5% glucose by clysis and infusion	
		2/19/37 Colostomy Spinal	3/17/37 7 45 A M	182	486	21 3	33 %	1 0276	7 %	Up in chair today Colostomy functioning Location of lesion Sigmoid To return for closure of colostomy later	Relieved 4/5/37
11	512603 B C 70 yrs Female	Obstruction due to strangulated femoral hernia 2 days	3/9/37 4 50 P M	190	348	19 7	49 %	1 0294	7 7%	W B C 12 700, P 89%, B P 150/100 Before operation given 1 500 cc of 5% glucose in Ringer s solution Ser chlorides 565 mg %, Bi CO_2 50 Ml /100 cc *Potassium content of spinal fluid 15 3 mg %*	
	Index 6	3/9/37 Reduction of strangulated hernia with imbrication	9 P M	184	342	19 4	48 %	1 0295	7 7%	At the end of operation *Potassium content of peritoneal fluid 12 5 mg %*	
		Spinal	3/14/37 8 15 A M	189	450	13 2	39 %	1 0257	6 4%	Has had 80 Gm of NaCl and 14 000 cc of fluid since last blood sample	Cured 3/27/37
12	399137 J R 72 yrs Male	Strangulated left indirect inguinal hernia	4/14/37 4 15 P M	222	373	20 4	54 %	1 0304	8 %	Admitted to medical ward Diagnosis Coronary? W B C 14 950, P 87%, R B C 6 840 000, Hb 105% Sp gr of blood 1 0598, B P 120/80 Electrocardiogram	
	Index 24	2 days	7 25 P M	233	421	17 5	51 %	1 0286	7 4%	T wave changes either due to myocardial damage or digitalis medication Has had	
		4/14/37	4/15/37 8 A M	250	487	16 1	49 %	1 0278	7 1%	2 000 cc of saline and 5% glucose by clysis Second blood taken after spinal and before infusion	
			4/16/37 8 A M	222	427	15 7	48 5%	1 0291	7 6%		
		Reduction of strangulation, repair of hernia	4/17/37 8 A M	216	404	14 3	50 %	1 0280	7 2%	*Potassium content of peritoneal fluid 28 6 mg %*	
			4/19/37 8 A M	205	383	15 7	49 5%	1 0288	7 5%	*Potassium content of spinal fluid at operation 14 7 mg %*	
		Spinal								Stay in hospital prolonged due to acute cystitis following retention of urine due to benign hypertrophy of prostate Location of lesion Ileum	Cured 5/10/37
13	516211 M B 65 yrs Male	Strangulated rt direct inguinal hernia 6 hrs 4/27/37	4/27/37 2 15 P M	226	427	20 4	48 %	1 0287	7 4%	No saline given before operation B P 170/98 1 500 cc of saline given by clysis postoper	
			4/28/37 8 A M	172	356	18 6	43 %	1 0250	6 2%		
	Index 8	Relief of strangulation, repair of hernia	4/30/37 8 A M	175	420	14 5	38 %			Has had 6 000 cc of saline by clysis since last blood analysis	
			5/1/37 8 30 A M	161	360	15 2	40 5%	1 0237	5 7%	Has had 1 500 cc of saline by clysis since last blood analysis	

(Continued on next page)

SYNOPSIS OF DATA (*continued*)

Case Number	Hospital Number Initials Age Sex	Type of Lesion Duration before Operation Date of Operation Anesthesia	Date and Time of Obtaining Blood	*Potassium in mg % in* Whole Blood	Cells	Plasma	Cell Volume by Hematocrit	Plasma Specific Gravity	Plasma Protein	Other Data and Remarks	Result Date of Discharge
		Spinal	5/6/37 7 50 A M	229	484	17 2	44 1%	1 0266	6 7%	Developed bronchopneumonia May 2	
			5/7/37	182	344	18 1	47 5%	1 0262	6 6%	Temperature normal Location of lesion Low ileum	Cured 5/20/37
14	312208 J S G 42 yrs Female	Strangulated postoperative ventral hernia	5/15/37 1 40 P M	185	383	16 9	43 9%	1 0298	7 8%	W B C 12 250, P 88% N P N 43 mg %, CO 64 Ml/100 cc Specific gravity of whole blood 1 0583 B P. 118/70. *Potassium content of peritoneal fluid 18 5 mg %*	
			4 30 P M	202	424	15 4	44 %	1 0307	8 1%	Sample taken during operation before infusion Culture of peritoneal cavity *B coli*	
		2 days	6 30 P M	186	390	17 4	43 3%	1 0265	6 6%	At end of operation after infusion 1 000 cc saline but before transfusion of whole blood	
		5/15/37								*Potassium content of gangrenous gut 637 mg %*	
			6 50 P M	191	368	19 0	46 6%			After transfusion of 500 cc of blood	
	Index no data	Resection of gangrenous ileum primary end to end anastomosis G -O -E	5/16/37 7 50 A M	183	387	20 7	41 8%	1 0261	6 5%	Has had 2 000 cc of saline intravenously since last analysis Nasal suction by Wangensteen tube all night *Potassium content of gastric fluid 42 4 mg %*	
		Autopsy Bilateral bronchopneumonia Extension of gangrene of ileum Leakage of site of anastomosis with peritonitis Infection of wound	5/17/37 7 50 A M	158	390	12 5	37 5%	1 0259	6 4%	Has had 3 000 cc of saline intravenously since last analysis Total amount of NaCl since admission 67 Gm Signs of pneumonia Temp 102°	
			5/18/37 7 50 A M	174	447	13 5	35 9%	1 0266	6 7%	Has had 2 500 cc more saline intravenously by continuous drip Ser chlorides 624 mg % Blood urea nitrogen 9 mg %, CO 39 Ml/100 cc before transfusion	
		Note At operation the strangulated loop had ruptured, local peritonitis	3 05 P M	145	366	13 2	36 %	1 0257	6 4%		
			4 10 P M	170	394	16 3	39 %	1 0258	6 4%	10 min after transfusion of 500 cc of blood Placed in oxygen tent	
			5/21/37 8 20 A M	148	347	13 0	39 %	1 0261	6 5%	Ser chlorides 672 mg % Blood urea N 7 mg %, CO 49 Ml/100 cc Blood culture No growth Temp 106° pulse 140 resp 36	
			4 40 P M	186	384	13 8	44 7%	1 0267	6 7%	This sample taken after transfusion and 16 hrs before death The patient went into shock the following morning and died with temp of 107 2° Location of lesion Terminal ileum	Died 5/22/37

15	445205 G R 68 yrs Male	Strangulated rt femoral hernia	5/20/37 1 P M	178	336	21 3	46 6%	1 0289	7 5%	No saline given before operation B P 178/80 This sample obtained on operating table before infusion	
		1 day	5/21/37 8 A M	228	480	16 5	44 2%	1 0238	5 8%	Has had 2 000 cc of saline since last blood sample	
	Index No data	5/20/37 Relief of strangulation, repair of hernia Local	5/24/37	188	332	17 3	51 6%	1 0271	6 9%	Nonprotein nitrogen 47 mg % Doing well Location of lesion Ileum	Cured 6/4/37
16	436642 R G 39 yrs Female	Obstruction due to postoperative adhesions about which there was a volvulus Hysterectomy 1934	5/21/37 1 P M	180	335	15 9	49 %	1 0310	8 2%	W B C 10 200, P 77% Roentgen ray Fluid levels in ileum Sp gr blood 1 0624 CO_2 combining power 75 3%, N P N 37 mg % Infusion of saline and 5% glucose given before operation	
		5 days	6 P M	166 7	346	13 5	44 4%	1 0274	7 %	Blood sample taken on operating table after infusion Second infusion 1 000 cc saline and 300 cc 5% NaCl *Potassium content of peritoneal fluid 13 2 mg %*	
	Index 12	5/21/37 Division of peritoneal bands Ileotomy	5/22/37 7 30 A M	145	332	15 4	39 %	1 0266	6 7%	Ser chlorides 624 mg % Blood urea nitrogen 16 mg % CO_2 51 Ml /100 cc Continuous infusion and gastric suction since operation *Potassium content of gastric fluid 65 8 mg %* Has had 4 560 cc of saline since admission	
		Spinal	5/23/37 7 40 A M	134 2	320	13 1	38 %	1 0260	6 5%	Has had 2 000 cc more of saline intravenously Gastric suction stopped last night	
			5/24/37 7 20 A M	121	324	14 1	32 9%	1 0245	6 %	R B C 3 820 000, Hb 61%, W B C 5 200, P 73% Given transfusion	
			5/27/37 8 A M	147	328	25 3	37 2%	1 0261	6 5%	Location of lesion Low ileum	
			6/3/37 8 30 A M	166	382	19 4	38 5%				Cured 6/19/37
17	524151 M McD 46 yrs Female	Obstruction due to incisional hernia	8/2/37							Obese florid patient Given spinal anesthesia	
		Distention ½ hrs Attacks of cramp like pain 1 wk	9 15 P M	192	373	20 1	46 %	1 0272	6 9%	Died on table B P 200/98 before operation Patient was extremely nervous and apprehensive Gas oxygen administered before spinal puncture Became cyanotic On admission sp gr of blood 1 0572 W B C 9 600, P 63% Urine Glucose ½+ alb 1+	
	Index 2	8/2/37 Spinal									Died 8/2/37

(*Continued on next page*)

SYNOPSIS OF DATA (*continued*)

Case Number	Hospital Number Initials Age, Sex	Type of Lesion Duration before Operation Date of Operation Anesthesia	Date and Time of Obtaining Blood	*Potassium in mg % in* Whole Blood	Cells	Plasma	Cell Volume by Hematocrit	Plasma Specific Gravity	Plasma Protein	Other Data and Remarks	Result Date of Discharge
18	456262 Γ L 59 yrs Female	Obstruction due to strangulated umbilical hernia	9/16/37 12 10 A M	162	302	15 3	48 4%	1 0264	6 6%	Sp gr whole blood 1 0556 CO_2 36 vol % Ser chlorides 496 mg % Bl sug 386 mg % After 1 000 cc of infusion R B C 4 400 000, Hb 96%, W B C 11 600, P 88%	
	Index	1½ days	1 15 A M	192 3	387	17 2	45 4%	1 0239	5 8%	Preop sample after infusion	
	20	9/16/37	7 50 A M	139 4	296	12 3	43 %	1 0235	5 7%	CO_2 39 vol % Bl urea N 19 mg %, bl sug 316 mg % *Potassium content of gastric suction 34 2 mg %*	
		Reduction of hernia with repair	1 45 P M	167	378	12 1	40 9%	1 0222	5 2%	Before transfusion of 500 cc of blood Sug 153 mg %	
			2 45 P M	167	366	12 3	42 1%	1 0232	5 5%	5 min after transfusion Ser chlorides 560 mg % Given 2 000 cc of Hartmann s solution	
		Local	9/17/37 8 30 A M	165	352	11 2	43 6%	1 0225	5 3%	CO_2 49 vol % Ser chlorides 542 mg % Bl sug 124 mg %	
			9/18/37 8 A M	172	371	10 4	43 6%	1 0222	5 2%	CO_2 56 vol % Ser chlorides 542 mg %	
			10/9/37 7 40 A M	191	386	16 2	45 2%	1 0263	6 6%	Blood sug 117, diabetes controlled C 100 P 60-F 50 35 units of protamine insulin	Cured 10/21/37
19	530547 L H 40 yrs Female	Obstruction due to strangulated femoral hernia	9/30/37 5 30 P M	225	371	23 5	54 4%	1 0305	8 %	W B C 22 500, P 93%, R B C 6 930 000, Hb 128% Sp gr of blood 1 0600 Given 2 000 cc of Ringer s Urine Alb o acetone o	
		19 hrs 9/30/37	8 P M	186	368	16 5	46 %	1 0290	7 5%	*Potassium in vomitus 46 1 mg %* Before operation but after infusion Gastric suction started after operation Given second infusion postop of 1 500 cc of Ringer s	
	Index 45	Reduction of hernia with repair	10/1/37 7 50 A M	153	340	14 7	40 8%	1 0230	5 5%	CO_2 44 vol % Ser chlorides 644 mg % Given two clyses 3 000 cc of dextrose and Ringer s	
		Spinal	10/2/37 6 30 A M	147	282	21 3	44 5%	1 0267	6 7%	*Potassium content of peritoneal fluid 17 2 mg %* CO_2 43 vol % Ser chlorides 592	
			10/8/37 8 A M	150	347	18 3	38 %	1 0252	6 2%	Oct 6 Bl urea N 6 mg % Smooth postoperative course	
			10/25/37 8 30 A M	174	382	17 2	41 %	1 0255	6 3%	Location of lesion Low ileum	Cured 10/25/37
20	108014 Γ O	Obstruction due to strangulated femora	10/1/37							Patient with m tral and aortic stenosis and	

20	408044 F O 52 yrs Male	Obstruction due to strangulated femoral hernia Cramp-like pain 65 hrs Vomiting 3 hrs	10/1/37 3 10 P M	157	321	27 8	40 2%	1 0293	7 6%	Patient with mitral and aortic stenosis and insufficiency admitted for bronchopneumonia Type III Developed hernia due to excessive coughing Bl chlor 572 mg % CO_2 70 vol %, B P 4 hrs postop 115/85
			6 30 P M	158	287	30 1	44 5%	1 0268	6 8%	Sample taken after operation Patient placed in oxygen room Given infusion 1 500 cc of Ringer s and 20 cc of eschatin Venous pressure before infusion 72 Mm
	Index 72	10/1/37 Resection of gangrenous Richter's type of hernia End-to end anastomosis Local and avertin	10/2/37 4 45 A M			21 3	37 8%	1 0283	7 3%	Went into shock 6 hrs postop 50% glucose intravenously plus 20 cc of eschatin and indirect transfusion 300 cc Profuse sweating B P 40/0 Pulse 170 Gastric suction functioned well Abd soft Infusion continued with 5% glucose and normal saline 40 cc of eschatin N P N 51 mg %, ser chlorides 614 mg %, CO_2 50 vol % 7 A M N P N 77 mg %, ser chlorides 600 mg %, CO_2 50 vol % 7 P M During 20 hrs before death the twitching of various muscle groups with carpopedal spasm on applying tourniquet was very striking 24 cc of digalen and two injections of 50% sucrose during 12 hrs *Potassium content of resected loop fluid 109 mg %* *Potassium content of gastric suction fluid 38 1 mg %* *Potassium content of urine 450 mg %* Location of lesion Low ileum (See chart for further details)
			7 15 A M	151	322	26 2	38 8%	1 0291	7 5%	
			2 15 P M	154	319	32 3	38 1%	1 0289	7 5%	
			7 P M	156	339	31 1	36 8%	1 0282	7 2%	
		Autopsy	Rheumatic endocarditis of mitral and aortic valves Mitral stenosis and insufficiency Aortic stenosis and insufficiency Cardiac hypertrophy and dilatation Lobular pneumonia Chronic passive congestion of lungs Peritoneal abscess localized Amebic abscess of liver obsolete Fibrous pleural and peritoneal adhesions							Died 10/2/37

FIVE CASES IN WHOM THE INITIAL BLOOD WAS TAKEN AFTER TREATMENT OR OPERATION

21	463986 B S 17 yrs Female	Obstruction due to postoperative adhesions 4¼ days	2/8/37 3 20 P M	161	351	15 1	41 5%	1 0227	5 4%	Patient admitted 2/5/37 with tentative diagnosis of acute cholecystitis Under observation for 3 days during which time she received two infusions of saline and 5% glucose and 1 000 cc of Ringer s solution by clysis The initial potassium determination done on blood taken before operation Roentgen ray Fluid levels
	Index on admission 8 Before operation 8	2/8/37 Division of adhesions G -O -E	7 40 P M	187	360	14 5	48 %	1 0232	5 5%	Taken at the close of operation
			2/10/37 4 15 P M	148	309	17 9	42 %	1 0211	4 8%	*Potassium in peritoneal fluid 16 3 mg %* Roentgen ray Pneumonia of rt lung Has had 5 000 cc of saline by infusion and clysis since last blood determination Gastric suction for two days
			2/24/37 7 30 A M	172	374	18 1	41 %			Location of lesion Lower ileum Cured 2/24/37

(Continued on next page)

SYNOPSIS OF DATA (*continued*)

Case Number	Hospital Number Initials Age Sex	Type of Lesion Duration before Operation Date of Operation Anesthesia	Date and Time of Obtaining Blood	*Potassium in mg % in* Whole Blood	Cells	Plasma	Cell Volume by Hematocrit	Plasma Specific Gravity	Plasma Protein	Other Data and Remarks	Result Date of Discharge
22	359290 J W 64 yrs Female	Obstruction due to postoperative adhesion causing gangrene of jejunum	1/7/37							Admitted with diagnosis of obstruction due to impacted feces in colostomy stoma R B C 5 010 000, Hb 95%, W B C 27 760, P 95% *Potassium content of fluid above obstruction 147 mg %*	
	Index on admission 16	24 hrs	1/8/37 9 30 A M	172	400	16 6	39 %	1 0267	6 7%	This blood was taken at the end of operation and after the patient had received 4 800 cc of Ringer s solution and 5% glucose *Potassium content of gastric suction 52 3 mg %*	
	Before operation 63	1/8/37 Resection of jejunum end to end anastomosis Contamination due to spilling of intestinal contents	11 45 A M	174	384	16 3	41 %	1 0243	5 9%	Before transfusion	
		Wound left open and treated with zinc peroxide Spinal	12 05 P M	178	366	20 6	43 %	1 0261	6 5%	After transfusion 600 cc of whole blood	
			1/9/37 7 30 A M	179	370	19 7	43 %	1 0246	6 %	Continuous infusion running B U N 21 mg % *Potassium content of gastric suction 61 6 mg %*	
			1/11/37 8 A M	166	420	14 9	36 %	1 0236	5 7%	Has had 10 000 cc of saline since last sample *Potassium content of gastric suction 35 1 mg %* R B C 3 820 000, Hb 68%	
		Wound culture Hem and nonhem strep Gram positive rods *B coli*	1/12/37 4 P M	152	403	15 1	34 %	1 0239	5 8%	Before transfusion *Potassium content of gastric suction 19 5 mg %*	
			4 20 P M	160	395	21 1	35 %	1 0293	7 6%	After transfusion of 500 cc of whole blood	
			1/14/37 8 20 A M	163	410	15 5	36 %	1 0223	5 2%	Gastric suction and continuous infusion discontinued	
			1/15/37 8 30 A M	142	315	12 3	41 %	1 0284	7 3%	Running a temperature of about 2 degrees, sloughs separating from wound	
			1/18/37 8 A M	134	360	10 0	34 5%	1 0267	6 7%	January 19 R B C 3 500 000, Hb 52%	
			1/20/37 8 A M	115	312	8 7	34 %	1 0240	5 8%	Running septic temperature	
			1/23/37 3 30 P M	125	454	16 2	24 %	1 0247	6 %	Before transfusion	
			4 P M	114	321	17 5	30 %	1 0258	6 4%	5 minutes after transfusion of 600 cc of	

			4 P M	114	321	17 5	30 %	1 0258	6 4%	5 minutes after transfusion of 600 cc of whole blood	
			1/28/37							R B C 2,700 000, Hb 42%, W B C 17 300, P 85% Serum chlorides 566 mg %, blood urea N 88 mg %	
			1/29/37							Given transfusion of 800 cc of whole blood One hour later suddenly became cyanotic and died 3½ hrs later Death attributed to possible anaphylactic reaction	
										Location of lesion Jejunum	Died 1/29/37
23	433160 W P 80 yrs Male Index 20	Obstruction due to multiple peritoneal adhesions 4 days	2/2/37					Specific gravity of whole blood		W B C 15 100, P 75% Roentgen ray Multiple fluid levels Given 4 000 cc of saline and 5% glucose by clysis Went into shock 10 hrs after operation	
		2/2/37 Division of peritoneal adhesions Enterostomy Spinal	2/3/37 4 20 P M	191	325	28 2	50 %	1 0597 (4 10 P M) 1 0500 (4 20 P M)		Venous pressure 65 Mm of water at 3 30 P M No blood could be obtained from the vein as the patient was in collapse 300 cc of 5% NaCl administered after which the blood was secured for analysis This blood obtained after 300 cc more of 5% saline	
			4 45 P M	182	352	23 9	45 %				
			6 40 P M					1 0567		Venous pressure 140 Mm of water at start of transfusion After 200 cc of blood 120 Mm of water After 200 cc more of blood 175 Mm of water Hence no more blood given Died 9 hrs later Autopsy Peritonitis	
										Location of lesion Middle and lower ileum	Died 2/4/37
24	514139 L A D 64 yrs Male	Strangulated femoral hernia Richter's type 2 days								W B C 9 700, P 82% with 'shift to left" Roentgen ray Fluid levels By the time the first blood analysis was made the patient had received 17 000 cc of saline solution by infusion and clysis Equivalent to 168 Gm of salt Bl Urea N 4/10/37 27 mg % Gastric suction maintained 4 days postoper Serum chlorides 700 mg %, CO_2 48 Ml/100 Given transfusion of 600 cc of whole blood at 11 30 A M This analysis before procedure *Potassium in gastric contents 45 0 mg %* Blood sample taken after transfusion Placed in oxygen tent Roentgen ray 'Confluent bronchopneumonia both lungs' Blood culture neg Fluid intake since admission 26 400 cc Bilateral pitting edema of legs Blood urea N 13 mg % Parenteral fluids stopped	
		4/8/37 Resection of small intestine with primary anastomosis Spinal	4/12/37 9 30 A M	192	490	15 5	36 %	1 0232	5 5%		
			11 20 A M	202	509	16 3	36 5%	1 0238	5 7%		
			11 45 A M	195	448	15 6	40 %	1 0262	6 6%		
			4/14/37 8 30 A M	222	482	15 1	43 %	1 0229	5 4%		

(*Continued on next page*)

SYNOPSIS OF DATA (*continued*)

Case Number	Hospital Number Initials Age Sex	Type of Lesion Duration before Operation Date of Operation Anesthesia	Date and Time of Obtaining Blood	*Potassium in mg % in* Whole Blood	Cells	Plasma	Cell Volume by Hematocrit	Plasma Specific Gravity	Plasma Protein	Other Data and Remarks	Result Date of Discharge
										Urine Sp gr 1 035 neg for alb gluc R B C 4 960 000, Hb 95% (April 16)	
			4/17/37 8 30 A M	170	352	11 5	45 %	1 0240	5 8%	Edema of lower extremities less Still in oxygen tent Removed from tent in afternoon	
			4/22/37 8 15 A M	202	376	21 4	48 %	1 0233	5 6%	Afebrile today On regular diet Blood sample taken 10 min after breakfast	
			5/6/37 8 A M	172	430	18 8	35 6%	1 0244	6 %	Discharged home today Location of lesion Middle ileum?	Cured 5/6/37
25	527974 V W 16 yrs Female	Volvulus of small intestine 36 hrs								Admitted for recurrent attacks of abdominal cramp like pain vomiting and distention with diagnosis of appendicitis Appendicectomy August 5 1937 Normal	
	Index 30	8/9/37 Jejunostomy after reduction of volvulus Spinal supplemented by G-O-E	8/9/37 1 45 P M	213	430	16 5	45 7%	1 0266	6 7%	appendix and some free fluid Pain vomiting and distention persisted R B C 6 000 000, Hb 98% sp gr of blood 1 0577 *Potassium content of gastric suction 46 9 mg %*	
			6 P M	170	318	15 5	48 7%	1 0248	6 1%	This sample after infusion operation and transfusion *Potassium content of intestinal fluid 32 7 mg %* *Potassium content of peritoneal fluid 17 4 mg %*	
			8/11/37 8 A M	143	316	13 1	40 9%	1 0239	5 8%	Kept in oxygen tent for 2 days Gastric suction maintained for 5 days *Potassium content of gastric suction 49 7 mg %*	
			8/12/37 10 A M	159	361	13 1	40 4%			CO_2 51 vol % Ser chlorides 602 mg % *Potassium content of enterostomy drainage 26 9 mg %* *Potassium content of gastric suction 18 5 mg %*	
			8/17/37 8 A M	160	374	12 4	39 5%	1 0238	5 8%	Bl Urea N 6 mg % *B coli* infection of wound	
			9/1/37 8 A M	170 3	364	14 2	43 %	1 0269	6 8%	Enterostomy tube removed 14 day Discharged today Average fluid intake for first week 4 600 cc a day Average daily sodium chloride 35 Gm	
										Location of lesion Twist at upper and lower ileum	Cured 9/1/37

obstruction, hemorrhage into the loop, and tissue necrosis together with inadequate excretion [107] Analysis of gangrenous loop fluid in four (Cases 5, 14, 20, and 22) revealed potassium content many times that of plasma, whereas, normally, the potassium content of succus entericus is the same as that of the plasma [20 128]

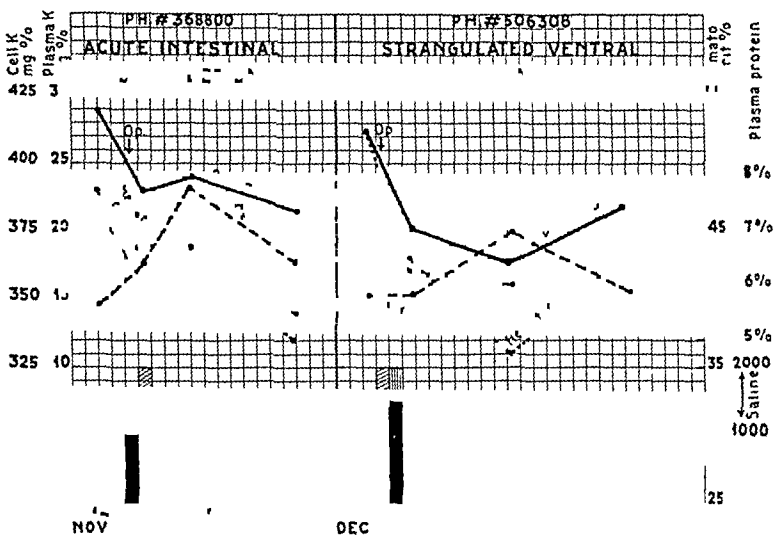


CHART 7.—Ordinates Days Abscissas Plasma and cell potassium plasma protein and hematocrit readings At bottom of chart the amount of fluid administered parentally is indicated Solid black represents intravenous Ringer's solution, slanting lines Ringer's solution by clysis See Cases 3 and 4 for details Note the fall in plasma potassium and the rise in cell potassium after the administration of saline solution Blood dilution is indicated by the fall in the hematocrit readings and plasma protein Recovery in both cases

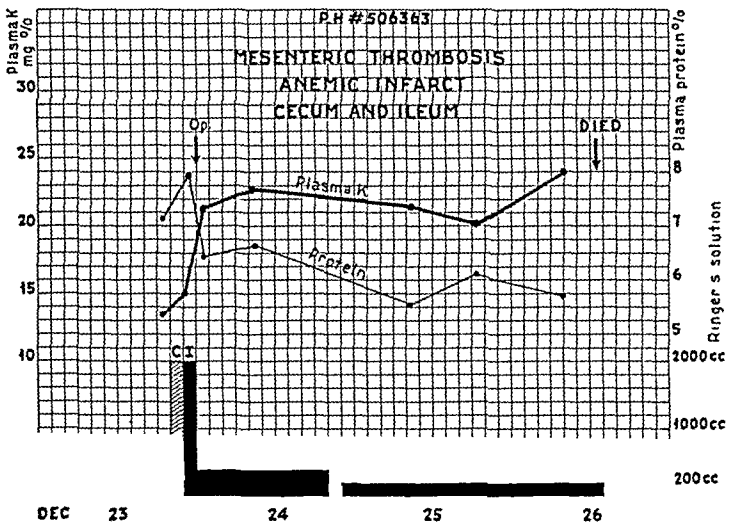


CHART 8.—Case 5 Ordinates Days Abscissas Plasma potassium and plasma protein In spite of the administration of saline solution the plasma potassium continued to rise Autopsy showed extension of the gangrenous process

A resection of the gangrenous loop with a primary anastomosis gave the best results in the moderately toxic patient[58] (Chart 6), probably for the following reasons (1) The exclusion of the danger of perforation, (2) the elimination of infection, (3) the removal of the necrotic portion of the intestine with its abnormally high potassium content, (4) the maintenance of the

continuity of the gastro-intestinal tract with its base and fluid conserving function

Enterostomy—In this series, a primary enterostomy with the relief of obstruction measurably increased the mortality rate (Chart 5) Its surgical

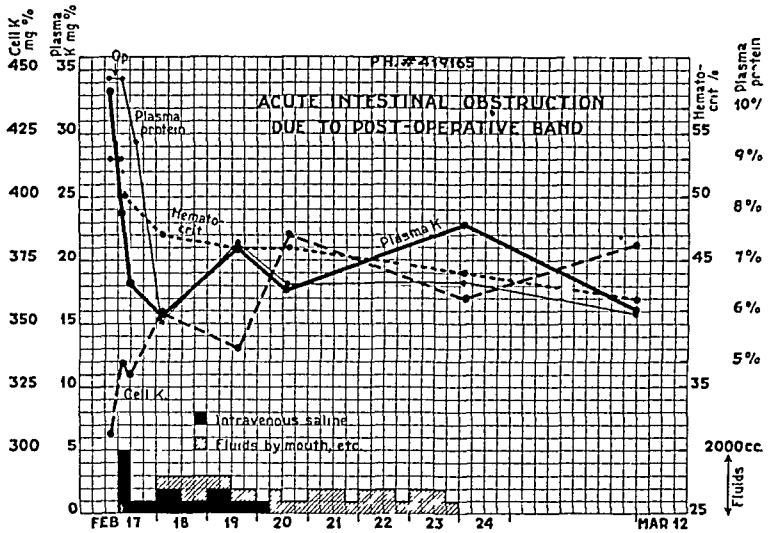


CHART 9—Case 9 Ordinates Days Abscissas Plasma and cell potassium plasma protein and hematocrit readings With the administration of saline solution the blood dilution is indicated by the fall in plasma protein and hematocrit readings Plasma potassium fell and the cell potassium rose

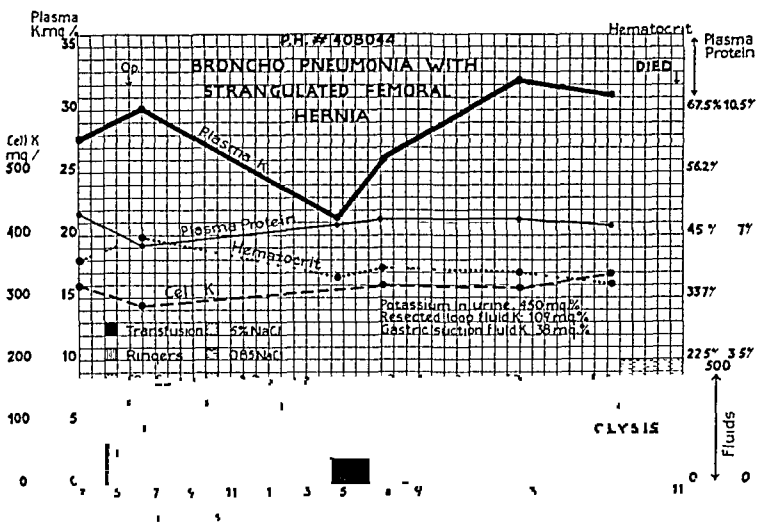


CHART 10—Case 20 Ordinates Time in hours Abscissas Plasma and cell potassium plasma protein and hematocrit readings At bottom of chart the types and amounts of fluids administered are detailed In estimation of the fluid loss, 1,500 cc were allotted to insensible perspiration See case report for details

merits have been controversial[28 65, 82 111, 122, 124] Haden and Orr,[41] Dragstedt,[25] and Morton and Pearse[86] have shown that animals with intestinal fistulae died with the same manifestations of toxemia, and as soon as animals with obstruction at the same level We have investigated the effect of complete intestinal fistulae upon both hemoconcentration and blood potassium and

find the resultant hyperpotassemia similar to that occurring in acute intestinal obstruction,[107, 108] experimental adrenal insufficiency,[123, 137] and experimental potassium poisoning[139]

The 70 per cent mortality following enterostomy *without* the removal of the lesion (Chart 5) may thus be explained by two factors (1) In failing to remove the obstruction, absorption of fluids and intestinal secretions is prevented, (2) the external loss of fluids and electrolytes through a fistula placed above the obstruction accentuates the dehydration with consequent earlier and greater rise in blood potassium[108]

Enterotomy—This was performed in 63 cases with a gross mortality of 57 per cent Comparing this group with the relief of obstruction and enterostomy, the mortality in the latter is 9 per cent higher and the recovery rate is less at each index (Chart 5) This contrasts with Holden's[52] success, ob-

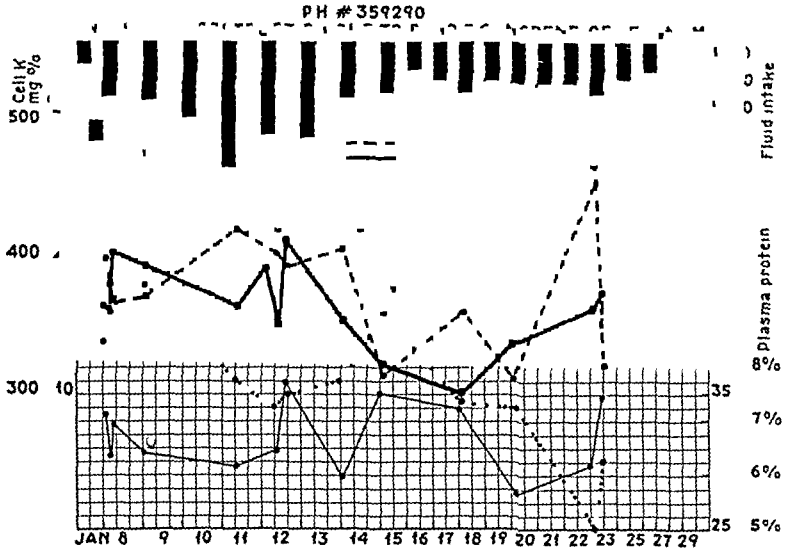


CHART 11—Case 22 Ordinates Days Abscissas Plasma and cell potassium, plasma protein and hematocrit readings Daily fluid balance is indicated at top of chart T indicates transfusion Note the fall in cell potassium following each transfusion, also the increase in plasma proteins

tained by relieving the obstruction, removing the intestinal content by stripping through an enterotomy, and the giving of hypertonic salt solution subcutaneously His procedure eliminates the toxic intestinal fluid (rich in potassium), preserves the continuity of the gastro-intestinal tract and combats a potential hyperpotassemia by the *adequte administration of salts and fluids* In our series, the gut was stripped in only two cases More chemical studies on both the blood and intestinal contents are needed in this controversy of enterotomy *versus* enterostomy[16, 62, 85, 87, 90, 115] Continued gastric suction has reduced the need for either[78, 95, 126]

Gastric Lavage—Introduced by Kussmaul[59] in the treatment of intestinal obstruction, gastric lavage is a recognized procedure The advent of continued gastric suction has carried the value of decompression one step farther Carlson[13] suggested some noxious element was washed out by vomiting In our experimental work, the abnormally high potassium content of the vomitus indicates that secretion of this base into the gastric lumen, followed by vomit-

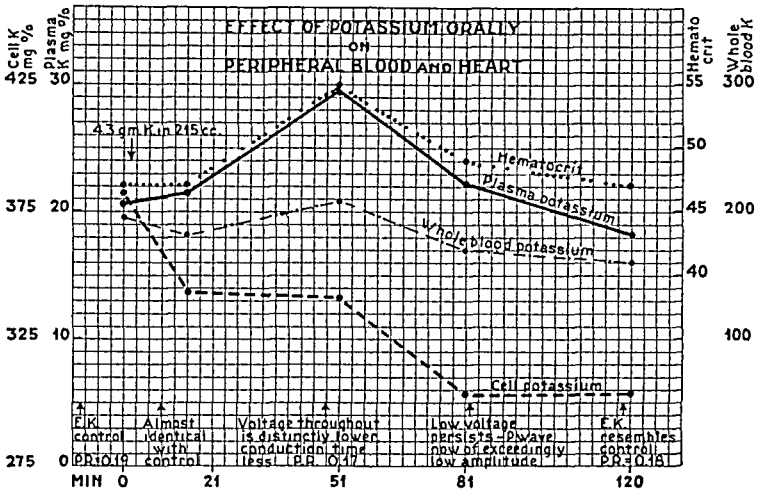


CHART 12.—Ordinates Time in minutes Abscissas Hematocrit readings Whole blood, plasma and cell potassium A summary of the electrocardiographic data is to be found at the bottom of the chart



CHART 13.—Electrocardiographic Report Leads 1 2 and 3 Taken September 8 1936 Control Sinus rhythm Ventricular rate 80 P–R = 0.17 to 0.19 Left preponderance P_3 inverted T_1, T_2 T_3 upright Well marked left preponderance is the chief finding

ing, may be regarded as part of an auxiliary or emergency mechanism for lowering blood potassium [34, 54, 107, 108] The values are reported in eight cases

Pulse in Obstruction—The slow pulse is often deceptive Eisberg[29] counsels against delaying operation until disturbances in the pulse become manifest

The action of potassium on the heart both *in vivo* and *in vitro* has been amply demonstrated [12, 22, 37, 53, 73, 79] Gautrelet[35] introduced into frogs' circul-

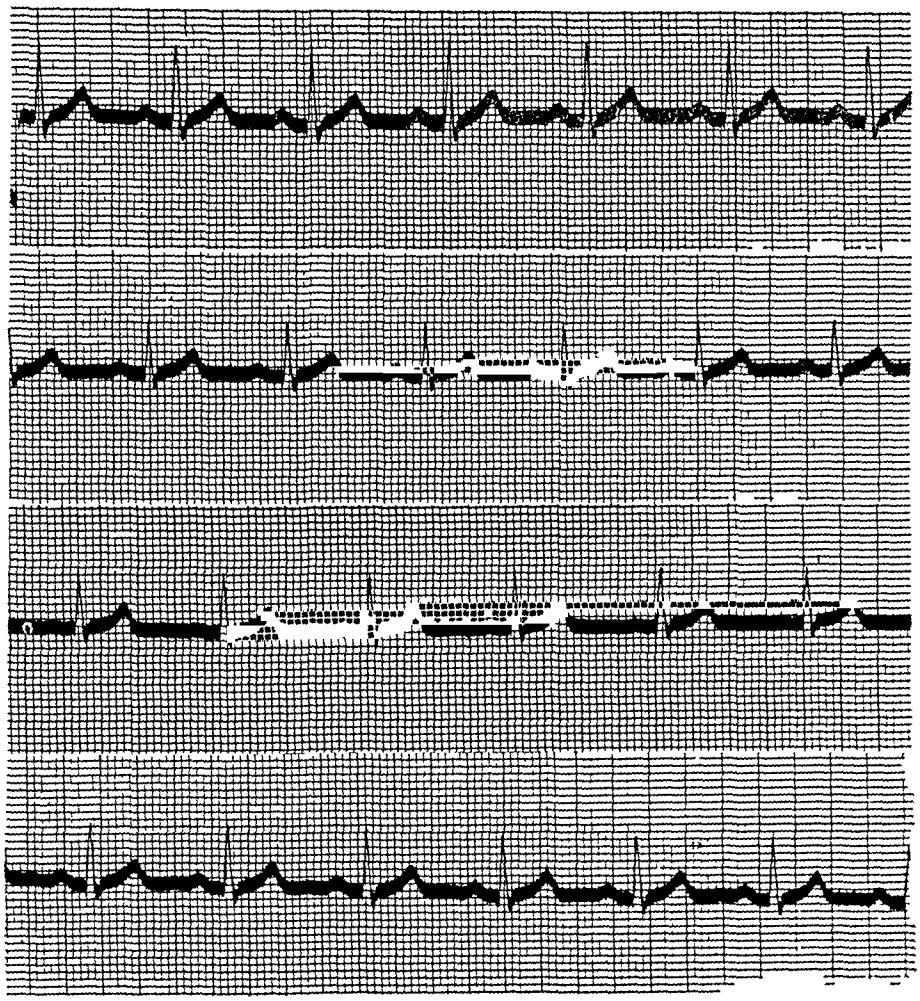


CHART 14—Electrocardiographic Report Series of lead 2 after taking potassium
Sec 1—sinus rhythm, ventricular rate 80 P–R = 0 19
Sec 2—sinus rhythm, ventricular rate 78 P–R = 0 17
Sec 3—sinus rhythm, ventricular rate 76 P–R = 0 15
Sec 4—sinus rhythm ventricular rate 80 P–R = 0 18
Section 1 is essentially identical with the control There is not however the variation in the P–R as noted in the control The form of the complexes is similar
Section 2 The voltage throughout is distinctly lower and the conduction time is less than before, being 0 17 throughout
Section 3 The low voltage persists the P waves now being of exceedingly low amplitude and the conduction time is further reduced to 0 15
Section 4 This resembles very closely the first section in that the voltage is higher than in the second and third sections The conduction time is greater

lation potassium ions obtained by electrolytic dissociation, and found that like potassium salts, they produce a decrease in the number of contractions, a gradual diminution in the amplitude of the beat, and finally cessation of the heart action, electrocardiograms taken resembled those of muscular fatigue

A relationship of hyperpotassemia to some of the peculiarities of heart action is suggested by two sets of experimental data and two human cases As part of a study of human potassium tolerance[138] one of us (J S) took 20 mg of potassium per pound of body weight Electrocardiograms taken at intervals revealed that with an increase of 50 per cent in the capillary plasma potassium, there occurred a slowing of the rate, a decrease in the p r interval and a decrease in the amplitude of the complexes, all of which disappeared within two hours, at which time the plasma potassium had returned to normal

A cat with a complete intestinal fistula showed, in addition to the above changes, T wave changes in leads two and three[108] Cats dying of potassium poisoning gave the following electrocardiographic changes Flattening and inversion of T waves in leads two and three, and intraventricular block and ventricular fibrillation[15]

Case Report—Case 2 A male, age 60, was admitted September 24, 1936, with the complaint of severe epigastric pain of eight hours' duration The past history was important as he had had a partial thyroidectomy for cardiac insufficiency due to hyperthyroidism in May, 1935 The patient was referred to the Medical Service with a tentative diagnosis of coronary thrombosis because his electrocardiogram was suggestive of severe heart muscle damage The exacerbations of the patient's pain, blood pressure, which remained constant, and good heart sounds were not consistent with coronary occlusion Difference of opinion delayed operation for two days An obstruction due to a band was found The electrocardiograms showed improvement after treatment The plasma potassium was 29 mg per cent before, and 17 mg per cent after operation and therapy

Dr Levy recalled another patient whose unusual history, absence of typical physical findings and electrocardiograms suggestive of severe heart muscle damage was watched for six days Necropsy revealed several feet of gangrenous intestine, but no heart disease

THE ACTION OF SALT—In four conditions associated with dehydration, salt solutions have proved beneficial *i e*, Asiatic cholera, fistulae of the gastrointestinal tract, adrenal insufficiency and acute intestinal obstruction

(1) *Cholera*—Although intravenous saline was first used by Latta,[60] during the 1831–1832 Edinburgh epidemic,[61] the mortality for this disease was not appreciably decreased until Rogers[99] [100] introduced his treatment The rediscovery of a low plasma bicarbonate by Sellards[109] [110] led to sodium bicarbonate therapy, which resulted in fewer cases of terminal uremia

(2) *Salt Treatment in Intestinal Fistulae*—Pawlow,[96] prolonged the lives of dogs with pancreatic fistulae by feeding sodium bicarbonate The administration of sodium chloride and sodium bicarbonate has yielded similar results in other types of fistulae of the gastro-intestinal tract[14] [26] [30, 32] [46] [86] [125]

(3) *Salt Treatment in Adrenal Insufficiency*—Soddu's[112] observation, in 1898, that adrenalectomized animals given salt lived longer, was neglected until recent confirmation[1] [5] [18] [43] [70] [102] [113] [134] Lowered alkaline reserve and the benefits of sodium bicarbonate and other sodium salts have been emphasized in this condition In the adrenalectomized animals, the giving of sodium bicarbonate in amounts proportional to the lowered CO_2 was suggested by Zwemer[140]

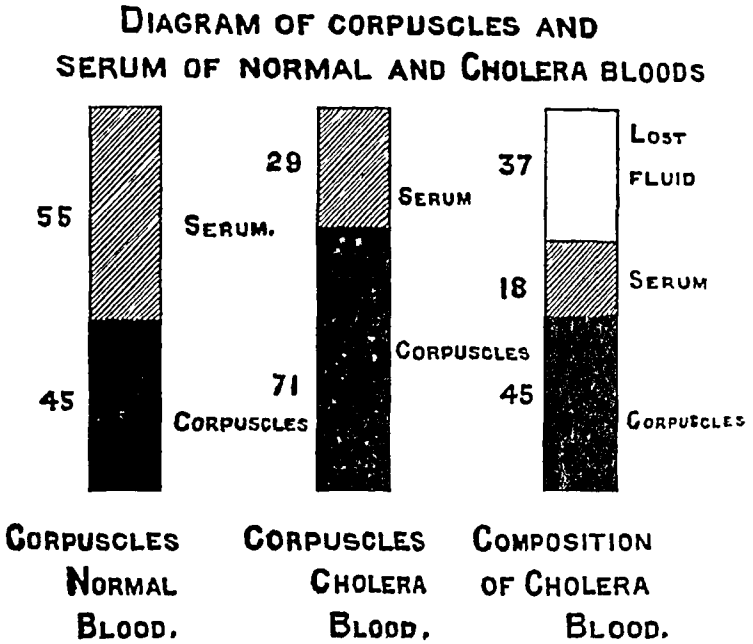


FIG 1.—Hematocrit readings (cell volume) of normal and abnormal blood (Rogers[100])

TABLE III

MORTALITY IN CHOLERA

Date	Type of Saline	Cases	Deaths	Mortality Per Cent
1831 (Latta and Mackintosh[61])	Saline intravenous	166		84
1893 (Wall[61])	Hypotonic subcutaneously	193		70
	Calcutta Medical College Hospital Series			
1895–1905	Rectal and subcutaneous hypotonic saline	1,243	783	59
1906	Normal saline intravenous	112	57	51
1907	Rectal and subcutaneous saline	158	94	59 5
1908–1909	Roger's hypertonic saline intravenous	294	96	32 6
1910–1914	Roger's hypertonic saline intravenous and permanganate per os	858	222	26
1915–1919	Roger's hypertonic and Roger's alkaline saline intravenous and permanganate per os	1,429	298	20 8

Formula for Roger's saline solution

Sodium chloride	Gr 120 (8 0 Gm)
Potassium chloride	Gr 6 (0 4 Gm)
Calcium chloride	Gr 4 (0 25 Gm)
Distilled water	one pint (568 cc)

This prescription, therefore, contains 15 2 Gm per liter, constituting a 1 52 per cent solution

(4) *Salt Treatment in Intestinal Obstruction*—Hartwell and Hoguet[48] showed the survival period in the obstructed dog was doubled by subcutaneous salt solution injections Similar to Rogers'[99, 100] treatment of cholera, Haden and Orr[40] have advocated hypertonic saline in bowel occlusion In the extremely toxic patient, Orr has urged a 2 per cent salt solution by hypodermoclysis, and a 3 to 5 per cent solution intravenously, the initial dose being 1 Gm of NaCl per Kg of body weight, in order to restore the blood chlorides

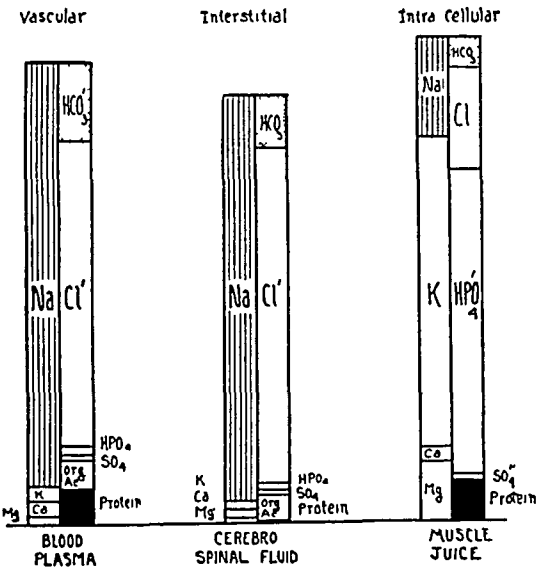


FIG 2.—Acid base composition of body fluids This diagram is constructed from average values for individual factors expressed in terms of acid base equivalence *i e*, as cubic centimeters of tenth normal solutions per 100 cc of fluid Base factors are superimposed in left hand and acid factors in right hand of each column They represent, as is actually the case a structure composed not of salt but of individually sustained concentrations of ions Exact acid base equivalence indicated by equal height of two parts of each column is obtained by adjustability of bicarbonate ion concentration (HCO_3) to any change elsewhere in structure (From McIver, M A Acute Intestinal Obstruction, New York, Paul B Hoeber Inc, 1934)

Hypertonic salt solutions shorten the survival in experimental adrenal insufficiency[76] It appears from our experience that these strong solutions should *not be used alone in severe dehydration* because the resultant blood dilution is accomplished by ingress of cell water

The similarity of the blood changes in the above four conditions is striking, and the values reported in the literature for three of them are given In each, the beneficial action of sodium solutions has been attributed to correction of the altered biochemical changes of the blood, maintenance of blood volume, or the washing out of a hypothetical toxin[100 102 105]

Since an increased blood potassium is found in certain phases of Asiatic cholera,[3 104] adrenal insufficiency, intestinal fistulae, and acute intestinal obstruction, the success of saline therapy[2 11 51 68 120] might be attributed in part to its effect on potassium metabolism

TABLE IV

	Asiatic Cholera	Adrenal Insufficiency	Acute Intestinal Obstruction
Physical Characteristics			
Red blood cells	Increased 71 100	Increased 36 101 114	Increased 38 81 121
Hemoglobin	Increased 71 100	Increased 44 101	Increased 4 10 64
White blood cells	Increased 92 100 129	Increased with terminal fall 13,	Increased 121
Specific gravity of blood	Increased 3 104 129	Increased 101 114	Increased 107
Hematocrit		Increased 7 44 114	Increased 4 38 81
Total solids	Decreased 3 93 94 99 104	Increased 23 36 47 101	Increased 65
Anions			
Cl	Decreased 67 94 110	Decreased 5 7 70 101 137	
HCO_3	Increased 66 71	Decreased 70 116 118 132	Decreased 10 31 34 39 50 72
HPO_4		Increased 47 69 116	Increased 31 34 39 72 80
SO_4	Increased 66	Increased 69	Decreased 81
Proteins	Decreased 66	Increased 49 114 117	Increased 4
Total acid		Decreased 118	Increased 4
Cations			Increased 4 31 33 81
Sodium	Decreased 3 104	Decreased 7 70 76 137	Decreased 4 31 34
Potassium	Increased 3 104	Increased 1 7 42 49 69 75 137	
Calcium	Increased 71	Increased 7 47	Decreased 4 31 34 50
Magnesium	Decreased 66	Increased 7 137	Increased 19 107
Total base	Increased 21	Decreased 7 45 69 137	Increased 50
Nonprotein Nitrogen	Increased 93 94	Increased 5 77 101	Increased 83
Urea	Increased 71	Increased 5 97 101 103	Decreased 4 31 34
Uric acid	Increased 71	Increased 47 103	Increased 17 24 38 119
Creatinine	Increased 66 67	Increased 42 47	Increased 24 38 83 119
Blood Sugar		Decreased 8 114 131 136	Increased 10 34
Hydrogen Ion Concentration		Increased 49 118 132	Increased 13 24
			Increased 50

SUMMARY

(1) Two thousand, one hundred fifty cases of acute intestinal obstruction, objectively analyzed, are reported with an evaluation of various surgical procedures used in relation to the patient's condition

(2) Twenty-five additional cases are given in detail with determinations of plasma and blood density, hematocrit, plasma proteins, plasma, whole blood and cell potassium together with other constituents of the blood before and after therapy

(3) The potassium contents of gangrenous loops, enterostomy drainage, gastric secretion, peritoneal and spinal fluids are given of several

(4) Disturbances in blood potassium resulting from derangements in body fluids explain some of the symptoms found and the procedures used in acute intestinal obstruction

(5) Hyperpotassemia is not peculiar to intestinal obstruction, but may be expected in all conditions associated with rapid, or excessive, entry of potassium into the blood stream together with dysfunction of the numerous regulatory mechanisms

We wish to express appreciation to the following hospitals and personnel for the use of their records

India American Presbyterian Hospital, Miraj, the late Dr C E Vail who inspired this study Bowring Hospital, Bangalore Kohlapur Mission Hospital, Dr N Dunning London Mission Hospital, Neyyoor, Dr I Orr and Dr T H Somervell Madras General Hospital, Madras, Sir Frank Connor, Surgeon General with the Government of Madras Mission Hospital, Ongole, Dr A G Boggs Missionary Medical College for Women, Vellore, Dr I S Scudder Mysore State Hospital, Mysore, Dr F Robinson Nagpur Mission Hospital, Nagpur, Dr Augustine Royapuram Hospital, Madras, Sir Frank Connor St Luke's Hospital, Vengurla, Dr R H H Goheen Scudder Memorial Hospital, Ranipet, Dr G Scudder

Ceylon Colombo General Hospital, Dr Briercliffe, Director of Medical Services in Ceylon

China Chinese Red Cross Hospital, Shanghai, Dr Yen Peking Union Medical College, Peking, Dr H H Loucks St Luke's Hospital, Shanghai, Dr A W Tucker and Dr J C McCracken

Hawaii Queens Hospital, Honolulu, Dr N P Larsen

Japan St Luke's Hospital, Tokyo, Dr Bowles

United States Billings Memorial Hospital and the University of Chicago Clinics, Chicago, Dr L G Dragstedt and Dr D Phemister Cook County Hospital, Chicago, Dr K Meyer Massachusetts General Hospital, Boston, Dr A W Allen and Dr E D Churchill Passavant Hospital, Chicago, Dr J Wolfer Peter Bent Brigham Hospital, Boston, Dr E Cutler Presbyterian Hospital, New York, Dr A O Whipple San Francisco Hospital, Dr L Eloesser and Dr H Brunn Stanford Hospital, San Francisco, Dr E Holman

Dr S B Wolbach, Harvard Medical School, for autopsy sections on the adrenals

Dr Louis Bauman for the blood chemical analyses (Chlorides, N P N, Blood Urea, CO_2)

Prof R L Levy and Dr H G Bruenn for the electrocardiograms

BIBLIOGRAPHY

[1] Allers, W D The Influence of Diet and Mineral Metabolism on Dogs after Suprarenalectomy Proc Staff Meet Mayo Clinic, 10, 406–408, 1935

[2] Amberg, S, and Helmholz, H F The Detoxifying Action of Sodium Salt on Potassium Salt in the Guinea Pig Jour Pharmacol and Exper Therap, 12, 19–35, 1918

[3] Aron, H The Chemical Composition of the Blood in Asiatic Cholera Philippine Jour Sci, 5, Sec B, 395–401, 1910

[4] Atchley, D W, and Benedict, E M The Distribution of Electrolytes in Intestinal Obstruction Jour Biol Chem, 75, 697–702, 1927

[5] Banting, F G, and Gairns, S Suprarenal Insufficiency Am Jour Physiol, 77, 110–113, 1926

[6] Barbour, H G, and Hamilton, W F The Falling Drop Method for Determining Specific Gravity Jour Biol Chem, 69, 625–640, 1926

[7] Baumann, E J, and Kurland, S Changes in the Inorganic Constituents of Blood in Suprarenalectomized Cats and Rabbits, Jour Biol Chem, 71, 281–302, 1927

[8] Bierry, H, and Malloizel, L Hypoglycemie apres decapsulation, effets de l'injection d'adrenaline sur les animaux decapsules Compt rend Soc de biol, 65, 232–234, 1908

[9] Braun, W, and Boruttau, H Experimental-kritische Untersuchungen ueber den Ileustod Deutsche Ztschr f Chir, 96, 544–597, 1908

[10] Brown, G E, Eusterman, G B, Hartman, H R, and Rowntree, L G Toxic Nephritis in Pyloric and Duodenal Obstruction, Renal Insufficiency Complicating Gastric Tetany Arch Int Med, 32, 425–455, 1923

[11] Bunge, G Ueber die Bedeutung des Kochsalzes und das Verhalten der Kalisalze im Menschlichen Organismus Ztschr f Biol, 9, 104–143, 1873

[12] Carlson, A J On the Chemical Conditions for the Heart Activity, with Special Reference to the Heart of Limulus III The Specific Influence of the Inorganic Salts of the Blood on the Heart Ganglion and the Heart Muscle Am Jour Physiol, 16, 378–408, 1906

[13] Carlson, H E, and Orr, T G Experimental Obstruction of Jejunum Effect of Administration of Water on Length of Life and Changes in the Chemical Composition of Blood Arch Surg, 28, 292–295, 1934

[14] Cavazza, F Su di alcune ricerche biochimiche nel sangue, nella bile e nel fegato di animali con fistola biliare permanente Pathologica, 27, 241–250, 1935

[15] Chamberlain, F, Scudder, J, and Zwemer, R L (In preparation)

[16] Cheever, D Operative Evacuation of Small Intestine in Paralytic Stasis New England Jour Med, 207, 1125–1131, 1932

[17] Cooke, J V, Rodenbaugh, F H, and Whipple, G H Intestinal Obstruction VI A Study of Non-Coagulable Nitrogen of the Blood Jour Exper Med, 23, 717–738, 1916

[18] Corey, E L The Effect of Forcing Fluids upon Survival after Bilateral Epinephrectomy Am Jour Physiol, 79, 633–640, 1927

[19] Cutler, E C, and Pijoan, M Certain Chemical Factors in Experimental High Intestinal Obstruction Surg, Gynec, and Obstet, 64, 892–894, 1937

[20] DeBeer, E J, Johnston, C G, and Wilson, D W The Composition of Intestinal Secretions Jour Biol Chem, 108, 113–120, 1935

[21] Dhar, D R, Dhar, H K, and Adhyee The Role of Non-Protein Nitrogen Content of Blood in Cases of Cholera Calcutta Med Jour, 25, 1, 1930

[22] Dogiel, J Ueber den Einfluss einiger Kalisalze auf Muskeln und Nerven Centralbl f d med Wissensch, 30, 354–356, 1892

[23] Donath, J Uber den Einfluss der Nebennierenexstirpation und des d-Suprarenins auf die Blutkonzentration bei Katzen Arch f exper Path u Pharmakol, 77, 1–15, 1914

[24] Draper, J W Intestinal Obstruction, Complete and Incomplete J A M A, 69, 1768–1772, 1917

[25] Dragstedt, L R Failure of Reabsorption of Gastric and Pancreatic Juice as a Pathogenic Factor in Some Gastrointestinal Disturbances Am Jour Surg, 11, 544–551, 1931

[26] Dragstedt, L R, and Ellis, J C The Fatal Effect of the Total Loss of Gastric Juice Am Jour Physiol, 93, 407–416, 1930

[27] Duliere, W L Donnees experimentales sur la repartition du potassium dans le sang extravase, comparaison entre la concentration physiologique dans le plasma et la concentration dans le liquide cephalorachidien Compt rend Soc de biol, 108, 416–418, 1931

[28] Dupuytren, G Quoted by McIver, M A Acute Intestinal Obstruction New York, Paul B Hoeber, Inc, 1934

[29] Eisberg, H B Diagnosis in Acute Mechanical Intestinal Obstruction Am Jour Surg, n s 2, 147–153, 1927

[30] Elman, R, and McCaughan, J M On Collection of Entire External Secretion of Pancreas under Sterile Conditions and Fatal Effect of Total Loss of Pancreatic Juice Jour Exper Med, 45, 561–570, 1927

[31] Gamble, J L, and McIver, M A A Study of the Effects of Pyloric Obstruction in Rabbits Jour Clin Invest, 1, 531–545, 1925

[32] Gamble, J L, and McIver, M A Body Fluid Changes Due to Continued Loss of External Secretion of Pancreas Jour Exper Med, 48, 859–869, 1928

[33] Gamble, J L, and McIver, M A The Acid-Base Composition of Gastric Secretions Jour Exper Med, 48, 837–847, 1928

[34] Gamble, J L, and Ross, S G The Factors in the Dehydration Following Pyloric Obstruction Jour Clin Invest, 1, 403–423, 1925

[35] Gautrelet, J De l'action sur le coeur de l'ion potassium dissocie et introduit par electrolyse Compt rend Soc de biol, 62, 1084–1085, 1907

[36] Gradinescu, A V Der Einfluss der Nebennieren auf den Blutkreislauf und den Stoffwechsel Arch f d ges Physiol, 152, 187–253, 1913

[37] Grandeau, L Experiences sur l'action physiologique des sels de potassium, de sodium et de rubidium injectes dans les veines J de l'anat et de la physiol, 1, 378–385, 1864

[38] Guest, G M, and Andrus W DeW Chemical Studies of the Blood in High Intestinal Obstruction, Distribution of Phosphorus and Intracellular Changes Jour Clin Invest, 11, 455–473, 1932

[39] Haden, R L, and Orr, T G Chemical Changes in Blood of Dog after Intestinal Obstruction Jour Exper Med, 37, 365–375, 1923

[40] Haden, R L, and Orr, T G Use of Sodium Chloride in the Treatment of Intestinal Obstruction J A M A, 82, 1515–1517, 1924

[41] Haden, R L, and Orr, T G High Jejunostomy in Intestinal Obstruction, a Clinical Review and Experimental Results J A M A, 87, 632–634, 1926

[42] Harrop, G A, Pfiffner, J J, Weinstein, A, and Swingle, W W Further Studies on the Adrenal Cortical Hormone Science, 73, 683–684, 1931

[43] Harrop, G A, Soffer, L J, Nicholson, W M, and Strauss, M B Studies on Suprarenal Cortex, Effect of Sodium Salts in Sustaining Suprarenalectomized Dog Jour Exper Med, 61, 839–860, 1935

[44] Harrop, G A, Soffer, L J, and Trescher, J H Studies on the Suprarenal Cortex, Metabolism, Circulation, and Blood Concentration During Suprarenal Insufficiency in the Dog Jour Exper Med, 58, 1–16, 1933

[45] Harrop, G A, and Weinstein, A Studies on the Suprarenal Cortex I Cortical Suprarenal Insufficiency and the Action of Cortical Hormone Upon the Normal and Suprarenalectomized Dog Jour Exper Med, 57, 305–333, 1933

[46] Hartmann, A F, and Elman, R The Effects of Loss of Gastric and Pancreatic Secretions and the Methods for Restoration of Normal Conditions in the Body Jour Exper Med, 50, 387–405, 1929

[47] Hartman, F A, MacArthur, C G, Gunn, F D, Hartman, W E, and MacDonald, J J Kidney Function in Adrenal Insufficiency Am Jour Physiol, 81, 244–254, 1927

[48] Hartwell, J A, and Hoguet, J P Experimental Intestinal Obstruction in Dogs with Especial Reference to the Cause of Death and the Treatment by Large Amounts of Normal Saline J A M A, 59, 82–87, 1912

[49] Hastings, A B, and Compere, E L Effect of Bilateral Suprarenalectomy on Certain Constituents of the Blood of Dogs Proc Soc Exper Biol and Med, 28, 376–378, 1931

[50] Hastings, A B, Murray, C D, and Murray, H A, Jr Certain Chemical Changes in the Blood after Pyloric Obstruction in Dogs Jour Biol Chem, 46, 223–232, 1921

[51] Hoffman, W S, and Post, W E Influence of Mineral Metabolism Upon Nephrotic Edema Jour Clin Invest, 12, 613–638, 1933

[52] Holden, W B Surgical Treatment of Acute Intestinal Obstruction Surg, Gynec, and Obstet, 50, 184–192, 1930

[53] Howell, W H An Analysis of the Influence of the Sodium, Potassium and Calcium Salts of the Blood on the Automatic Contractions of Heart Muscle Am Jour Physiol, 6, 181–206, 1901–1902

[54] Ingraham, R C, and Visscher, M B Inverse Concentration Ratios for Sodium and Potassium in Gastric Juice and Blood Plasma Proc Soc Exper Biol and Med, 30, 464–466, 1933

[55] Ingvaldsen, T, Wripple, A O, Bauman, L, and Smith, B C The Rôle of Anhydremia and the Nature of the Toxin in Intestinal Obstruction Jour Exper Med, 39, 117–127, 1924

[56] Kramer, B, and Tisdall, F F Clinical Method for the Quantitative Determination of Potassium in Small Amounts of Serum Jour Biol Chem, 46, 339–349, 1921

[57] Kramer, B, and Tisdall, F F The Distribution of Sodium, Potassium, Calcium and Magnesium Between the Corpuscles and Serum of Human Blood Jour Biol Chem, 53, 241–252, 1922

[58] Knight, G C Intestinal Strangulation Brit Jour Surg, 25, 209–226, 1937

[59] Kussmaul and Cahn, A Heilung von Ileus durch Magenausspulung Berl klin Wchnschr, 42, 669–672, 43, 685–687, 1884

[60] Latta, T Malignant Cholera Documents Communicated by the Central Board of Health, London, Relative to the Treatment of Cholera by the Copious Injection of Aqueous and Saline Fluids Into the Veins Lancet, 2, 274–277, 1831–1832

[61] Latta and Mackintosh Quoted by Wall, A J Asiatic Cholera, Its History, Pathology and Modern Treatment London, H K Lewis, 1893

[62] Lawen, A Zur operation des Ileus Zentralbl f Chir, 54, 1037–1045, 1927

[63] Leichtenstern, O Constrictions, Occlusions and Displacements of the Intestines Cyclopedia of the Practice of Medicine (Ziemssen) New York, Wood, 499, 1876

[64] Leichtenstern, O Quoted by Nothnagel, H Diseases of the Intestine and Peritoneum Edited by H D Rolleston Philadelphia, Saunders, 7, 396, 1904

[65] Lee, W E, and Downs, T McK Treatment of Acute Mechanical Intestinal Obstruction by High Temporary Jejunostomy Annals of Surgery, 80, 45–50, 1924

[66] Liu, S H, Fan, C, and Wang, S H Acidosis in Cholera II Changes in Serum Electrolytes Proc Soc Exper Biol and Med, 30, 419–420, 1933

[67] Liu, S H, Wang, S H, and Fan, C Acidosis in Cholera I Part of Displacement of Serum Acid Base Equilibrium Proc Soc Exper Biol and Med, 30, 417–418, 1933

[68] Loeb, J The Ratio of the Concentration Required for the Accelerating and Antagonistic Action Upon the Diffusion of Potassium Salts Jour Biol Chem, 28, 175–184, 1916

[69] Loeb, R F Chemical Changes in the Blood in Addison's Disease Science, 76, 420–421, 1932

[70] Loeb, R F, Atchley, D W, Benedict, E M, and Leland, J Electrolyte Balance Studies in Adrenalectomized Dogs with Particular Reference to the Excretion of Sodium Jour Exper Med, 57, 775–792, 1933

[71] Loh, V T, and Tai, T Y A Study of the Blood in Cholera Chinese Med Jour, 50, 651–664, 1936

[72] MacCallum, W G, Lintz, J, Vermilys, H N, Leggett, T H, and Boas, E Effect of Pyloric Obstruction in Relation to Gastric Tetany Bull Johns Hopkins Hosp, 31, 1–7, 1920

[73] Macht, D I The Action of Potassium and Sodium Iodides and of the Iodine Ion on the Heart and Blood Vessels Bull Johns Hopkins Hosp, 25, 278–284, 1914

[74] Maizels, M Permeation of Erythrocytes by Cations Biochem Jour, 29, 1970–1982, 1935

[75] Maranon, G, Collazo, J A, Barbudo, J, and Torres, I Metabolismo mineral y del aqua en la entermedad de Addison ionemia c hidremia, hiperpotasemia en los accidentes graves Arch de med cir y especialid, 37, 893–900 1934

[76] Marine, D, and Baumann, E J Duration of Life After Suprarenalectomy in Cats and Attempts to Prolong It by Injections of Solutions Containing Sodium Salts, Glucose and Glycerol Am Jour Physiol, 81, 86–100, 1927

[77] Marshall, E K, and Davis D M Influence of the Adrenals on the Kidneys Jour Pharmacol and Exper Therap, 8, 525–550, 1916

[78] Matas, R The Continued Intravenous "Drip," with Remarks on the Value of Continued Gastric Drainage and Irrigation by Nasal Intubation with a Gastroduodenal Tube (Jutte) in Surgical Practice ANNALS OF SURGERY 79, 643–661, 1924

[79] Mathison, G C The Effects of Potassium Salts Upon the Circulation and Their Action on Plain Muscle Jour Physiol, 42, 471–494, 1911

[80] McCann, W S A Study of the Carbon Dioxide-Combining Power of the Blood Plasma in Experimental Tetany Jour Biol Chem, 35, 553–563, 1918

[81] McIver, M A, and Gamble, J L Body Fluid Changes Due to Upper Intestinal Obstruction J A M A, 91, 1589–1592, 1928

[82] McKenna, C H Drainage of Upper Intestinal Loop for Relief of Ileus, Based Upon Eight Clinical Cases Successfully Operated, and Animal Experimentation Surg, Gynec, and Obstet, 17, 674–681, 1913

[83] McVicar, C S A Discussion of the Clinical and Laboratory Clinical Findings in Certain Cases of Obstruction in the Upper Gastro-Intestinal Tract The Rôle of Blood Chemistry in Diagnosis, Prognosis and Treatment of This Condition Am Jour Med Sci, 169, 224-235, 1925

[84] Miller, C J Study of 343 Surgical Cases of Intestinal Obstruction ANNALS OF SURGERY, 89, 91–107, 1929

[84a] Mortality Statistics, United States Department of Commerce, Bureau of the Census Washington, 1920–1934, Government Printing Office

[85] Morton, J J The Treatment of Ileus, as Indicated by Clinical Experience and Experimental Studies ANNALS OF SURGERY, 95, 856–877, 1932

[86] Morton, J J, and Pearse, H E, Jr Similarity in Effect of Experimental High Intestinal Obstruction and High Complete Intestinal Fistula ANNALS OF SURGERY, 94, 263–268, 1931

[87] Moynihan, B Abdominal Operations Ed 4 Philadelphia, W B Saunders Company, 1, 1926

[88] Myers, V C Chemical Changes in the Blood and Their Clinical Significance Physiol Rev, 4, 274–328, 1924

[88a] Nilson, H W Corticoadrenal Insufficiency Metabolism Studies on Potassium, Sodium and Chloride Am Jour Physiol, 118, 620–631, 1937

[89] Nothnagel, C W H Diseases of Intestines and Peritoneum Edited by H D Rolleston Philadelphia, Saunders, 8, 343–400, 1904

[90] Ochsner, A, and Storck, A H Mechanical Decompression of the Small Intestine in Ileus J A M A, 108, 260–266, 1937

[91] Orr, T G, and Haden, R L Use of Sodium Chloride in the Treatment of Intestinal Obstruction J A M A, 82, 1515–1517, 1924

[92] O'Shaughnessy, W B Chemical Pathology of Cholera Remarks on "Dr Thomson's Analysis of the Blood of Individuals Affected with Malignant Cholera" Lancet, 2, 225–232, 1831–1832

[93] O'Shaughnessy, W B Analysis of the Blood in Cholera London Med Gaz, 9, 486–487, 1832

[94] O'Shaughnessy, W B Report on the Chemical Pathology of the Malignant Cholera Containing Analyses of the Blood, Dejections, etc, of Patients Labouring Under that Disease in Newcastle and London, etc London, S Highley, 1832

[95] Paine, J R, Carlson, H A, and Wangensteen, O H The Postoperative Control of Distention, Nausea and Vomiting A Clinical Study with Reference to the Employment of Narcotics, Cathartics, and Nasal Catheter Suction-Siphonage J A M A, 100, 1910–1917, 1933

[96] Pawlow, I P The Work of the Digestive Glands Lectures Translated into English by W H Thompson London, C Griffin and Co, Limited, 2nd ed, 1910

[97] Porak, R, and Chabanier, H Altération de la secretion renale apres l'ablation des glandes surrenales Compt rend Soc de biol, 77, 440–442, 1914

[98] Richardson, E P Acute Intestinal Obstruction, Study of Second Series of Cases from Massachusetts General Hospital Boston Med and Surg Jour, 183, 288–298, 1920

[99] Rogers, L The Treatment of Cholera by Injections of Hypertonic Saline Solutions with a Simple and Rapid Method of Intra-abdominal Administration Philippine Jour Sci, 4, Sec B, 99–105, 1909

[100] Rogers, L Cholera and Its Treatment London, Henry Frowde, Oxford University Press, 1913

[101] Rogoff, J M, and Stewart, G M Studies on Adrenal Insufficiency in Dogs II Blood Studies in Control Animals Not Subjected to Treatment Am Jour Physiol, 78, 711–729, 1926

[102] Rogoff, J M, and Stewart, G N Studies on Adrenal Insufficiency IV The Influence of Intravenous Injections of Ringer's Solution Upon the Survival Period in Adrenalectomized Dogs Am Jour Physiol, 84, 649–659, 1928

[103] Rowntree, L G Studies in Addison's Disease J A M A, 84, 327–335, 1925

[104] Schmidt, C Zur Characteristik der epidemischen Cholera gegenuber verwandten Transsudationsanomalien Leipzig u Mitau G A Reyher, Being 1 Thiel of Zur Kenntniss des vegetativen Lebens, 1850

[105] Schnohr, E A Study on Cause of Death in High Intestinal Obstruction Observations on Chlorine, Urea and Water Acta chir Scandinav (Supp 33), 75, 1–176, 1934

[106] Scudder, J A Yardstick of Acute Intestinal Obstruction, a Preliminary Report Based on 570 Cases Jour Christian Med Assn India, 10, 287–290, 1935

[107] Scudder, J, Zwemer, R L, and Truszkowski, R Potassium in Acute Intestinal Obstruction Surgery, 1, 74–91, 1937

[108] Scudder, J, and Zwemer, R L The Effect of Complete Intestinal Fistula on Blood Potassium Surgery, 2, 519–531, 1937

[109] Sellards, A W Tolerance for Alkalies in Asiatic Cholera Philippine Jour Sci, Sec B, 5, 363–389, 1910

[110] Sellards, A W, and Shaklee, A O Indications of Acid Intoxication in Asiatic Cholera Philippine Jour Sci, Sec B, 6, 53–76, 1911

[111] Shelley, H J Enterostomy, Consideration of the Literature Arch Surg, 25, 943–957, 1932

[112] Soddu, L Intorno agli effetti della estirpazione delle capsule surrenali nel cane Sperimentale Arch di biol, 52, 87, 1898

[113] Stewart, H A On Certain Relations Between Lipoid Substances and the Adrenals

Tr Internat Cong Med, 1913 London, 1914 sect iii Gen Path and Path Anat, Pt 2, 173–181, 1913

[114] Stewart, G N Blood Studies in Dogs After Adrenalectomy Jour Pharmacol and Exper Therap, 29, 373–380, 1926

[115] Storck, A H, and Ochsner, A Mechanical Decompression of the Intestine in Treatment of Ileus I Effect of Stripping on Blood Pressure Arch Surg, 33, 664–669, 1936 II Effect on Intestinal Activity Arch Surg, 33, 670–695, 1936

[116] Sullivan, R C, MacLean, A B, and Zwemer, R L A Comparison of the Chemical Composition of the Blood in Acute Intestinal Intoxication and Experimental Adrenal Insufficiency in Animals Am Jour Dis Child, 43, 1279–1281, 1932

[117] Swingle, W W Studies on Functional Significance of Suprarenal Cortex, Blood Changes Following Bilateral Epinephrectomy in Cats Am Jour Physiol, 79, 666–678, 1927

[118] Swingle, W W, and Eisenman, A J Studies on Functional Significance of Suprarenal Cortex Acid-Base Equilibrium of Epinephrectomized Cats Am Jour Physiol, 79, 679–688, 1927

[119] Tileston, W, and Comfort, C W, Jr The Total Nonprotein Nitrogen and the Urea of the Blood in Health and in Disease, as Estimated by Folin's Methods Arch Int Med, 14, 620–649, 1914

[120] Thaler, J I Evidence of Permeability of Tissue Cells to Potassium Proc Soc Exper Biol and Med, 33, 368–371, 1935

[121] Toennis, W, and Brusis, A Veraenderungen des morphologischen Blutbildes bei akuter und chronischer Darminhaltsstauung (Ein Beitrag zur intestinalen Autointoxikation) Deutsche Ztschr f Chir, 233, 133–146, 1931

[123] Treves, F Intestinal Obstruction Its Varieties, with Their Pathology, Diagnosis, and Treatment Philadelphia, Henry C Lea & Co, 1884

[123] Truszkowski, R, and Zwemer, R L Cortico-Adrenal Insufficiency and Potassium Metabolism Biochem Jour 30, 1345–1353, 1936

[123a] Truszkowski, R, and Zwemer, R L Determination of Blood Potassium Biochem Jour, 31, 229–233, 1937

[124] Van Beuren, F T, Jr, and Smith, B C Status of Enterostomy in Treatment of Acute Ileus, Statistical Inquiry Arch Surg, 15, 288–297, 1927

[125] Walters, W, and Bollman, J L Toxemia of Duodenal Fistula, Physiologic Changes Concerned in Production of Its Characteristic Chemical Reactions of Blood J A M A, 89, 1847–1853, 1927

[126] Wangensteen, O H, and Paine, J R Treatment of Acute Intestinal Obstruction by Suction with the Duodenal Tube J A M A, 101, 1532–1539, 1933

[127] Weech, A A, Reeves, F B, and Goettsch, E The Relationship Between Specific Gravity and Protein Content in Plasma, Serum, and Transudate from Dogs Jour Biol Chem, 113, 167–174, 1936

[128] Welch, C S, Masson, J C, and Wakefield, E G Clinical and Laboratory Findings After Excessive Loss of Intestinal Fluid from the Ileum Surg, Gynec, and Obst, 64, 617–621, 1937

[129] Wittstock, C Chemical Researches Into the Nature of Cholera Lancet, 1, 169–171, 1833–1834

[130] Wohl, M G, Burns, J C, and Clark, J H Adrenal Glands in Dogs With High Intestinal Obstruction Proc Soc Exper Biol and Med, 33, 543–546, 1936

[131] Wyman, L C, and Walker, B S Studies on Suprarenal Insufficiency IV The Blood Sugar in Suprarenalectomized Rats Am Jour Physiol, 89, 215–222, 1929

[132] Yonkman, F F Acid Intoxication of Adrenal Insufficiency in Dogs Am Jour Physiol, 86, 471–482, 1928

[133] Zwemer, R L A Study of Adrenal Cortex Morphology Am Jour Path, 12, 107–114, 1936

[134] Zwemer, R L An Experimental Study of the Adrenal Cortex II Prolongation of Life After Complete Epinephrectomy Am Jour Physiol, 79, 658–665, 1927
[135] Zwemer, R L, and Lyons, C Leucocyte Changes After Adrenal Removal Am Jour Physiol, 86, 545–551, 1928
[136] Zwemer, R L, Smith, J M, and Shirley, M The Adrenal Cortex and Blood Sugar Anat Rec, 45, 250, 1930
[137] Zwemer, R L, and Sullivan, R C Blood Chemistry of Adrenal Insufficiency in Cats Endocrinology, 18, 97–106, 1934
[138] Zwemer, R L, and Truszkowski, R Factors Affecting Human Potassium Tolerance Proc Soc Exper Biol and Med, 35, 424–426, 1936
[139] Zwemer, R L, and Truszkowski, R The Importance of Cortico-Adrenal Regulation of Potassium Metabolism Endocrinology, 21, 40–49, 1937
[140] Zwemer, R L The Adrenal Cortex and Electrolyte Metabolism Endocrinology, 18, 161–169, 1934

SHORT-INTERVAL STAGE OPERATIONS FOR SEVERE HYPERTHYROIDISM

ARTHUR B McGRAW, M D

DETROIT, MICH

FROM THE DEPARTMENT OF SURGERY OF THE HENRY FORD HOSPITAL, DETROIT, MICH

NOTWITHSTANDING the continued improvements that from time to time have been devised in pre- and postoperative care, multiple stage operations still offer the best solution for the conduct of safe, yet adequate, surgical relief of the extremely toxic goiter patient Their value has been repeatedly cited and amply demonstrated by various authors, but the intrinsic problems and alternatives of the operative procedures themselves have not always received proportionate attention It is with some of these latter problems that this report is concerned

Stage operations for hyperthyroidism, if one may judge from articles on the subject in periodicals and in text-books, are nearly always performed by one of two classical methods The first method[1 2 3 4, 7, 14, 17] consists of the exposure of the superior thyroid poles through separate, short incisions, permitting ligation of the polar arteries or, at least, their main branches These polar ligations can be effected rapidly, almost bloodlessly, and if necessary without bringing the patient to the operating room A subsequent subtotal thyroidectomy can then be performed after whatever interval the patient's improvement permits In the days before our present knowledge of the efficacy of iodine as a preoperative measure,[22] such preliminary polar ligations were the only safe way to deal surgically with an extremely toxic goiter In the light of present knowledge about preoperative treatment, more than ligations can often be accomplished safely at the first stage Furthermore, there is the unsightliness of the additional two small scars to consider The other classical method[8 13 15 16 18 19, 21] is that of performing a subtotal hemithyroidectomy as a first stage, discharging the patient on a strict convalescent regimen for a period of usually not less than six weeks, then rehospitalization for preparation and subtotal removal of the other thyroid lobe In the case of some very sick patients a series of operations may be necessary, commencing with ligations and followed by lobectomies Under ideal conditions, and with patients who both can and will cooperate during the interval between operations, this second type of delayed operation is probably the method of choice, being safe in both stages, free from the risk of infection attending the early reopening of a wound, and on completion productive of as satisfactory an ultimate result as a single stage operation on a less toxic patient Certain local factors, however, led us to seek, long ago, an alternate way of handling those goiter patients in whom some type of stage operation was obviously the only safe procedure Such a method, its development, and its results in our hands, in 161 consecutive cases over a period of the past 13 years, are herewith described

The factors referred to above which complicated our delayed stage operations were largely social and economic The great majority of our patients, goiter or otherwise, were in the self-supporting, but low wage earning, stratum of factory workers and their wives, many of them had had only an elementary education, and many were of alien birth, unable or imperfectly able to speak and understand English The number of women in this group was just double that of the men, a preponderance much less than that reported by various authors [24] Some of these patients thought they were so much improved by a single lobectomy that they would not return for the second operation Others waited long beyond the requested interval and returned for the second operation with their original degree of hyperthyroidism fully recurrent Others found the economic strain made invalidism or even strict rest between operations difficult or impossible, with the result that their condition before the second operation was sometimes more precarious than it had been previous to the first These factors combined to make delayed stage operations an unsatisfactory procedure in our hands

Forced to make some compromise, and wishing if possible to use only a single period of hospitalization by shortening the interval between stage thyroidectomies, we first tried to consider the theoretic possibilities and then put them to clinical test We knew that with the use of fine silk suture material, strictest asepsis, and gentle technic, wounds, even those of operations on the central nervous system, could be reopened without ensuing infection, after the lapse of but a few days' time [5, 6, 11, 12] It furthermore seemed probable that the optimum time for reopening a clean wound would lie in the period after the edema and other reactions to operative trauma had largely subsided and before vascularization and cicatrization had proceeded to a point where they would complicate a second operation—i e , somewhere between the fifth and twelfth postoperative days The crux of our problems was whether or not sufficient clinical improvement for a safe reoperation would dependably occur within the above mentioned interval, when early reopening of a thyroid wound would least likely result in infection or poor healing After trial and observation of time intervals varying from one day to two weeks, we became convinced that the optimum period for "short-interval" stage thyroidectomies is from seven to ten days between operations After bilateral ligation of the superior polar arteries, and more strikingly after subtotal hemithyroidectomy, it is surprising how rapidly clinical improvement occurs after the first critical 36 to 48 hours have passed

Table I shows certain facts about 189 consecutive stage thyroidectomies performed during the years 1924 through 1936 These represent 12 per cent of the 1435 thyroidectomies performed during the same period Before 1928, when the relative incidence of goiter patients began to decrease,[20] 19 per cent of our thyroidectomies were performed in stages, but since 1928 only 8 per cent Section (A) indicates our experience with delayed two-stage operations

TABLE I

TYPES OF TWO STAGE THYROIDECTOMIES

(189 Consecutive Cases, 1924–1936)

	Total Cases	Operative Mortality	Wound Infection
(A) Delayed (4–6 wk interval)	14	21%	7 0%
(B) Reoperation within 48 hrs			
1—Wound closed after 24–36 hrs	13	0%	7 5%
2—Double lobectomy 48 hrs after ligation	1	100%	0 %
(C) Reoperation after 6–12 days			
1—Double lobectomy completed after bilateral ligation	94	0%	23 0%
2—Separate lobectomies completed	48	0%	10 5%
3—Other combinations of procedure	19	49% *	15 0%

* This mortality figure is accounted for by the fact that Group 3 includes all patients who *survived operations of more than two stages, also all patients who failed to survive the* operations planned for them

The high mortality (21 per cent) in our small series of 14 operations of this type was partly responsible for our efforts to shorten the interval, even though we did not feel that the mortality was due to any fault in the underlying principles of delayed stages themselves We laid it rather to our inability to get the patients to cooperate in applying the principles correctly Sections (B) and (C) deal with the patients upon whom operation was not delayed beyond 12 days In 13 toxic patients upon whom the complete operation was performed, the wound was packed open as a time saving safety measure, and sutured on the first or second subsequent day No infection occurred after these operations We rejected this type of stage operation, however, because we did not think it advisable to employ it on extremely toxic patients, and felt that a reduction of the amount of surgery on the gland itself was a more important safety factor than a mere reduction of the time of operation by the few minutes involved in wound closure Of the 161 "short-interval" stage operations, 94, or 58 per cent, first had a bilateral superior polar ligation through a collar incision After an interval varying from six to 12 days, the original wound was reopened and a subtotal bilateral excision was performed as the second and final stage Forty-eight patients, or 30 per cent, had first one lobe and later the other lobe subtotally resected after a similar interval and likewise through the same collar incision Among the 20 remaining cases various combinations were tried, usually three stage operations beginning with a bilateral ligation, followed by one and later a second subtotal lobectomy, all performed through the same collar incision The basic technic of all operations in this series was that originally developed by Kocher in Switzerland and Halsted in this country and described by the latter in his "Operative Story of Goiter"[9] In various details, suggestions in a more recent illustrated descriptive article by Halsted's pupils, Reid and

Andrus,[23] were followed Silk was used in every case After making the usual collar incision and freeing the sternohyoid and sternothyroid muscles of one side along their mesial borders, the upper pole was first carefully freed from its blood supply and mobilized, thus aiding a safe yet thorough exposure of the middle portion and lower pole This done, excision of the entire upper pole and all but a small posterolateral slice of the remainder of the lobe was proceeded with, working from the periphery toward the trachea and isthmus Where two separate lobectomies were performed, sufficient exposure was usually obtained at the second operation by retracting the sternohyoid and sternothyroid muscles laterally Where preliminary ligations were effected, the resulting edema and induration of these ribbon muscles at the second operation hindered exposure and often necessitated transverse division between clamps

TABLE II

DURATION OF HOSPITALIZATION

Average number of days in hospital before operation	12 9
Average number of days in hospital between stages	8 8
Average number of days in hospital after second stage	10 5
Average total days in hospital	32 2

Table II deals with the period of hospitalization of these "short-interval" cases At the present time, and for some years past, the usual hospital stay of a moderately toxic goiter patient is seven days before operation and eight to ten days after operation The table shows the average number of days elapsing before the first stage, between stages, and after the second stage The extra number of days before the first operation is reasonably accounted for by the severe degree of toxicity of these cases The number of days after the final operation, however, is only at the upper limit of what we usually find adequate for less toxic patients with complete operations The total number of days in the hospital averaged 32 2 This suggests that a "short-interval" procedure for stage thyroidectomies will save a patient on an average a week's hospital stay in addition to the four weeks of invalidism and economic dependence necessary between discharge after the first of two delayed-stage operations and reentry to prepare for the second operation It furthermore eliminates poor cooperation on the patient's part and any tendency not to return for the second operation Our care of patients between stages has consisted simply in replacing them on their original preoperative regimen of rest, high fluid and carbohydrate intake, Lugol's solution, and mild sedation as soon as their immediate reaction to the first operation permits This is usually possible by the third day In selecting the day for the second operation we have been guided mainly by the patient's temperature, pulse, condition of wound, clinical appearance and subjective symptoms of improvement A significant drop in the metabolic rate early after the first operation has occurred so seldom that had we depended on this sign alone we would not have operated a second time within so short a period A few patients have been told in

advance that stage operations were to be performed, but most of them have not been told until the morning of the second operation

TABLE III

EVIDENCE OF SEVERE HYPERTHYROIDISM

Initial preop B M R +70% or higher	29% of series
Initial preop B M R +50% or higher	74% of series
Initial B M R below +50% but with associated toxic myocarditis	45% of series
Highest postop rectal temp above 103° F	40% of series
Highest postop rectal temp above 102° F	74% of series
Average preop pulse pressure	70 Mm Hg

Table III summarizes some clinical observations, and is presented as showing the severe toxicity or otherwise complicated nature of the series of cases under consideration

TABLE IV

OPERATIVE MORTALITY AMONG 161 "SHORT-INTERVAL" OPERATIONS

(A) Gross mortality		12 deaths	7 5% of group
(B) After 94 operations planned for initial ligations		11 deaths	11 5% of subgroup
(a) After ligation only		in 7 instances	
(b) After ligation + single lobectomy		in 1 instance	
(c) After ligation + bilateral lobectomy		in 2 instances	
(d) After ligation and 2 separate lobectomies		in 1 instance	
(C) After 48 operations planned as 2 separate lobectomies (This death occurred after the first lobectomy)		1 death	2 0% of subgroup
(D) Assigned causes of death—whole group			
(a) Myocardial failure		10 instances	
(b) Acute hyperthyroidism		9 instances	
(c) Pneumonia		2 instances	
(E) Deaths by age decades—whole group			
10–19 yrs group	5 patients	0 deaths	0 0% of group
20–29 yrs group	24 patients	0 deaths	0 0% of group
30–39 yrs group	51 patients	2 deaths	3 9% of group
40–49 yrs group	35 patients	0 deaths	0 0% of group
50–59 yrs group	32 patients	5 deaths	15 5% of group
60–69 yrs group	14 patients	5 deaths	36 0% of group
Total	161 patients	12 deaths	7 5% of group

Table IV deals with the operative mortality of this series In the "short-interval" group of operations 12 patients should be considered operative deaths These deaths are analyzed in Table IV Not only were all of these patients severely toxic, but nine of the 12 were advanced thyrocardiacs, and two subject, in addition, to attacks of angina pectoris For eight months of the current year (1937) we have had at our disposal a newly developed type of oxygen tent for immediate postoperative use [10] The tent is operated by the gradual vaporization of liquid oxygen Its use has given such satisfactory aid in reducing or abolishing the severe reaction of toxic patients to operation that we have hopes of lowering the mortality rate in our future stage operations on patients who are very poor risks

TABLE V

POSTOPERATIVE COMPLICATIONS OTHER THAN WOUND INFECTION

(Entire Series of 189 Stage Operations)

Hypothyroidism	24 — 12 5%	Shock	2 — 1 1 %
Recurrence	22 — 11 5%	Pneumonia	2 — 1 1 %
Vocal cord paresis	18 — 9 5%	Hematoma	2 — 1 1 %
Death	15 — 8 0%	Acute hemorrhage	1 — 0 55%
Acute hyperthyroidism	14 — 7 5%	Tetany	1 — 0 55%
Myocardial failure	13 — 7 0%		

Table V shows the postoperative complications other than infection encountered in this series in the descending order of their frequency The vocal cord weakness or paralyses were all unilateral They occurred in 12 5 per cent of the separate lobectomies and in 10 5 per cent of the stage operations where only ligations were performed first In the matter of recurrent or persistent hyperthyroidism, however, the difference in results between the two types of short-interval operation is more significant Eighteen of the 21 recurrences were in operations other than two separate lobectomies, the percentages being 17 and 6 respectively Some degree of hypothyroidism occurred postoperatively in 24 patients These patients represent 13 5 per cent of the entire series Subtracting the recurrent and hypothyroid patients leaves 74 5 per cent with an entirely satisfactory ultimate result

TABLE VI

WOUND INFECTION

(Entire Series of 189 Stage Operations)

Total	32 — 17 0%
Brief	23 — 12 8%
Protracted	5 — 2 6%
Severe	3 — 1 6%
Contributory to death	0 — 0 %
Permanently disfiguring	0 — 0 %
In prelim ligation operations	22 — 23 0%
In 2 lobectomy operations	5 — 10 5%

Of all complications, however, wound infection has been the most frequent and given us the most serious concern We believe, though, that we have learned some points about its control Were it not for the facts shown in Table VI, which lists every wound in which there was the slightest deviation from clean healing, and were it not for our belief that every infection can be laid to some observed or undetected flaw in technic, we would long ago have abandoned trying to shorten the interval between stages As 82 5 per cent of wounds healed per primam, as three-quarters of the infections were of a transient and trivial nature, and as no wound infections contributed to operative mortality or caused permanent disfigurement, we feel this disagreeable complication is one that can be progressively reduced by ever increasing care in technic Infection occurred only half as frequently in separate single lobectomies as in all other types of operation, 10 5 per cent as against 21 5 per cent

DISCUSSION

In addition to the use of fine silk and careful hemostasis throughout both operations, it is of great importance and help to avoid bleeding wherever possible, especially during dissection of the skin flaps by care in keeping in the proper tissue planes and by avoiding all unnecessary tearing or section of vessels The quantity of ligature material left in the subcutaneous tissues is thus materially lessened If the patient's condition permits, unilateral lobectomy is the first stage operation of choice It gives proportionately more symptomatic relief and improvement within the subsequent interval of seven to ten days and permits one to leave the remaining lobe with its fascial and muscular coverings unmolested until the second stage is undertaken We consider this noninterference with the unoperated lobe very important At the first stage, furthermore, the entire isthmus and pyramidal lobe, if present, should also be thoroughly removed—even at the expense of dealing first with the smaller of two diffusely hyperplastic lobes At the second operation the region of the previously operated thyroid fossa should be left strictly untouched, sponged, or explored At the conclusion of the first stage it is preferable to omit subcutaneous suture of the skin flaps, to use skin clips for the skin edges rather than through-and-through sutures, and to avoid draining the wound Before proceeding with the second operation, the slightest imperfection in wound healing should be allowed to clear up completely The incision line and neck should receive very thorough but gentle preoperative cleansing The wound should be reopened gently and slowly, to cause as little subcutaneous bleeding as possible, and to allow any area in the wound suspicious of infection to be detected before the wound is widely opened and the temptation not to postpone the operation great During the second operation the already operated side should be left as strictly untouched as was the other lobe at the first operation At the end of the second operation the wound should again be reclosed without subcutaneous skin sutures and again preferably with skin clips Contrary to our original fears the final scars of these two stage operations have surprised us with their excellence The matter of drainage after the second operation must be left to the operator's judgment in the individual case No drains should be left in situ more than 24 hours With the above mentioned precautions in technic, a short-interval two stage thyroidectomy is submitted as an operation that can safely and satisfactorily be employed as an alternative to delayed stage operations for patients with severely toxic goiter

SUMMARY

(1) Certain goiter patients for reasons usually involving their financial or educational status do not cooperate satisfactorily in the conduct of two stage thyroidectomies where the operations are spaced four to six weeks apart

(2) The feasibility is discussed of conducting the entire surgical treatment of such goiter patients within a single period of hospitalization of a month or less through shortening the interval between operations to a week or ten days

(3) A consecutive series of 161 such "short-interval" two stage thyroidectomies is presented, the results analyzed by tables and discussed

(4) Technical points of two stage operations are described, chiefly those tending to minimize the risk of wound infection These include the use of silk, great care to avoid incurring unnecessary bleeding as well as meticulous hemostasis, avoidance of subcutaneous sutures in closure of the wound

The author wishes to express his indebtedness to Dr Roy D McClure, Surgeon-in-Chief, Henry Ford Hospital, Detroit, Mich, for the privilege of collaborating in the study and surgical procedures of this series of patients and for permission to review the cases considered herein for the purposes of this report Appreciation is also made to Dr Edward Campelli for his help in the preparation of the tables

REFERENCES

[1] Crile, G W Graves' Disease A New Principle of Operating Based on a Study of 352 Operations J A M A, 56, 637–641, 1911

[2] Crile, G W Surgical Treatment of Exophthalmic Goiter Surg, Gynec & Obstet, 30, 27, January, 1920

[3] Crile, G W Protection of the Patient in Surgery of the Thyroid Surg, Gynec & Obstet, 32, 213, March, 1921

[4] Judd, E S Results in the Treatment of Exophthalmic Goiter N Y State Med Jour, 20, 287, September, 1920

[5] Halsted, W S The Treatment of Wounds, etc, Surgical Papers of W S Halsted, 1, 105–106, Baltimore, Johns Hopkins Univ Press, 1924

[6] Halsted, W S The Employment of Fine Silk in Preference to Catgut, etc J A M A, 60, 1119–1126, 1913, also Surgical Papers of W S Halsted, 1, 29–37, Baltimore, Johns Hopkins Univ Press, 1924

[7] Halsted, W S The Preliminary Ligation of the Thyroid Arteries, etc Annals of Surgery, 58, 178–182, 1913, Pt II, Tr Am Surg Assn, 31, 319–321, 1913, also Surgical Papers of W S Halsted, 2, 220, Baltimore, Johns Hopkins Univ Press, 1924

[8] Halsted, W S The Excision of Both Lobes of the Thyroid Gland for Graves' Disease Annals of Surgery, 58, 178–182, 1913, Pt I, Tr Am Surg, Assn, 31, 312–318, 1913, also Surgical Papers of W S Halsted, 2, 222, Baltimore, Johns Hopkins Univ Press, 1924

[9] Halsted, W S The Operative Story of Goiter—The Author's Operation Johns Hopkins Hospital Reports, Baltimore, 19, 17–257, 1920, also Surgical Papers of W S Halsted, 2, 366, Baltimore, Johns Hopkins Univ Press, 1924

[10] Hartman, F W A New Type of Oxygen Tent—Shown at the Scientific Exhibit of the 1937 Annual Meeting of the American Medical Association Details not yet published

[11] Heidenhain, L Ersetzung des Katgut durch Seide—Replacement of Catgut by Silk Centralbl f Chir, 26, 225–230, 1899

[12] Kocher, Th Eine einfache Methode zur Erzielung Sicherer Asepsis—A Simple Method of Achieving Safer Asepsis Corr Bl f Schweiz Aerzte, 18, 3–20, 1888

[13] Lahey, F H Multiple Stage Measures in Surgery of Severe Hyperthyroidism J A M A, 78, 1862–1865, June, 1922

[14] Lahey, F H Preliminary Ligations in Thyroidism Surg Clin North America, 4, 1373–1377, December, 1924

[15] Lahey, F H Reduction of Mortality in Hyperthyroidism New England Jour Med, 213, 475–479, September, 1935

[16] Lahey, F H Stage Operations in Hyperthyroidism Surg Clin North America, 15, 1611–1624, December, 1935

[17] Lahey, F H, and Schwalm, L J Pole Ligation in Treatment of Hyperthyroidism Surg, Gynec & Obstet, 63, 69–76, July, 1936
[18] Lahey, F H Stage Operations in Severe Hyperthyroidism ANNALS OF SURGERY, 104, 961–970, December, 1936
[19] Lahey, F H The Management of Severe Hyperthyroidism Surg, Gynec & Obstet, 64, 304–312, February (No 2 A), 1937
[20] McClure, R D The Incidence of Operations for Goiter in Southern Michigan—Effect of Iodized Salt After Twelve Years' General Use J A M A, 109, 782–785, September, 1937
[21] Marshall, S F, and West, T H Stage Operations in Severe Hyperthyroidism Surg Clin North America, 16, 1567–1581, December, 1936
[22] Plummer, H S Results of Administering Iodin to Patients Having Exophthalmic Goiter J A M A, 80, 1955, 1923
[23] Reid, M R, and Andrus, W DeW The Surgical Treatment of Goiter With Special Reference to Operative Technic Arch Surg, 24, 531–549, April, 1932
[24] Rolleston, H D The Endocrine Organs in Health and Disease, Oxford University Press, 219, 1936

FACTORS INFLUENCING PROGNOSIS IN CARCINOMA OF THE BREAST *

HERBERT H DAVIS, M D

OMAHA, NEBR

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF NEBRASKA COLLEGE OF MEDICINE, OMAHA, NEBR

THERE are many excellent articles in the literature concerning the prognosis of carcinoma of the breast Many surgeons have studied this from the clinical viewpoint and many pathologists have attempted to estimate the prognosis upon an histologic study of the tumor There have been very few reports correlating clinical and pathologic study

A clinical classification is presented The histologic classification of Haagensen is used It is hoped that these classifications may be used in future studies at larger hospitals and clinics In this way we may learn the prognosis of cases of certain extent and microscopic type Thus we may determine, for example, that a carcinoma of the breast with only pectoral gland metastasis of a comedo carcinoma type results in a certain percentage of cures This is much more satisfactory than stating that one surgeon cures 35 per cent of his cases while another cures only 25 per cent The former surgeon probably sees earlier stages of the disease due to caring for a more intelligent class of people

A standard method of study of these cases, giving both clinical and microscopic types and stages of the disease, should have approximately the same results if treated similarly After finding these results, the value of various forms of treatment can be better determined

This study is based upon a careful review of 60 cases of carcinoma of the breast cared for in private practice at Immanuel Hospital by my father, B B Davis, and myself, also upon 23 cases at the University of Nebraska Hospital treated by various surgeons In both groups the study begins at the earliest date that microscopic sections of the tumors were kept for record This began at Immanuel Hospital in 1922, and at the University of Nebraska Hospital in 1927 No cases are included that were admitted for treatment later than 1932, so that there are at least four years intervening since they were first seen I have personally reviewed the histories, studied the microscopic sections and obtained reports of their present condition No effort is being made to prove any certain fact but the study is made merely to see what the results have been It is realized that this series of cases is far too small to justify one in drawing very definite conclusions from them

In the operable cases the treatment was radical mastectomy by one of the standard methods, removing the breast and dissecting out the axilla, with re-

* Read before the Western Surgical Association, Kansas City, Mo, December 12, 1936 Submitted for publication April 12, 1937

moval of the lymph nodes there Exception was made in only three cases In these a simple mastectomy without axillary dissection was performed In addition to radical mastectomy, postoperative roentgen-therapy was carried out in ten cases and preoperative radiation in three In recent years I have used preoperative radiation much more frequently Recurrence has usually been treated by irradiation and occasionally by local excision

TABLE I

BREAST CASES

Hospital	Cases Studied	Benign Microscopically	Carcinoma				
			Primary Operable			Recurrent	
			Total	No	Per Cent	No	Per Cent
Immanuel 1922–1932 (private cases)	60	6	51	51	94	3	6
University 1927–1932	23	2	19	15	71	2	9
Totals	83	8	70	66	88	5	7

TABLE II

PRIMARY BREAST CARCINOMA
OPERABLE CASES

Results—November, 1936

Hospital	Total	Operated	Results Known	Well		Dead							
				No	Per Cent	Carcinoma Deaths		Operative Deaths		Other Causes		Total	
						No	Per Cent	No	Per Cent	No	Per Cent	No	Per Cent
Immanuel	51	51	41	12	29	25	61	2	5	2	5	29	70
University	15	14	13	4	31	8	61	1	7	0	0	9	69
Total	66	65	54	16	30	33	61	3	6	2	3	38	70

In the early years of the study, six cases in the Immanuel Hospital series were diagnosed on their records as carcinoma which, on study of the sections, I believe were benign Four of these I know to be well but have not been able to follow-up the other two The diagnosis in 54 cases was carcinoma, checked either by microscopic section or by death from metastases Fifty-one of these cases were operated upon I know the results in 41, 12 of which are well now, which is a period of four to 14 years after operation This is 29

per cent of the traced cases The percentage of five-year so-called cures is actually higher as several of the cases reported as dead were well for longer than five years Besides this, two cases had operative deaths and two died of causes unrelated to the carcinoma

Of 13 traced University Hospital cases, four, or 31 per cent, are now well In the combined series I know the results in 54 out of 65 operated cases Of the 54, 16 cases, or 31 per cent, are well while 33 cases, or 61 per cent, are dead as a direct result of the carcinoma The other eight deaths were not due to carcinoma itself

The average age of the patients upon admission was 53½ years The youngest proved case was 28 Most of the cases previously diagnosed carcinoma, but which I consider benign, were of the younger age groups The oldest case was 80

TABLE III

AGE INCIDENCE

Age	Immanuel				University				Total			
	No	Unknown	Result		No	Unknown	Result		No	Unknown	Result	
			Well	Dead			Well	Dead			Well	Dead
20–29	0	0	0	0	1	0	0	1	1	0	0	1
30–39	5	0	1	4	1	0	0	1	6	0	1	5
40–49	12	4	5	3	9	2	1	6	21	6	6	9
50–59	23	2	5	16	5	0	1	4	28	2	6	20
60–69	9	3	1	5	3	0	1	2	12	3	2	7
70–79	3	1	0	2	2	0	1	1	5	1	1	3
80	1	0	0	1	0	0	0	0	1	0	0	1
Age not stated	1	1	0	0	0	0	0	0	1	1	0	0
Totals	54	11	12	31	21	2	4	15	75	13	16	46

It is seen that 61 cases, or 81 per cent, were between the ages of 40 and 69 The series is inconclusive in proving any age group more malignant than the others A much larger series of cases is needed

Chart 1 indicates that the private cases came for treatment somewhat earlier than the University Hospital cases In the former, 16 were operated upon within a month of the time of the first symptom In the University Hospital series only two presented themselves that early and one of those was admitted for trouble other than the carcinoma of the breast, which was discovered in the course of the routine physical examination Thirty-six, or 67 per cent, of the private cases were seen within two months of the onset During the same length of time only five, or 24 per cent, of the University Hospital cases were admitted In another series of 60 cases at the University

Hospital which was reviewed two years ago it was found that 50 per cent had had symptoms for over one year before admission

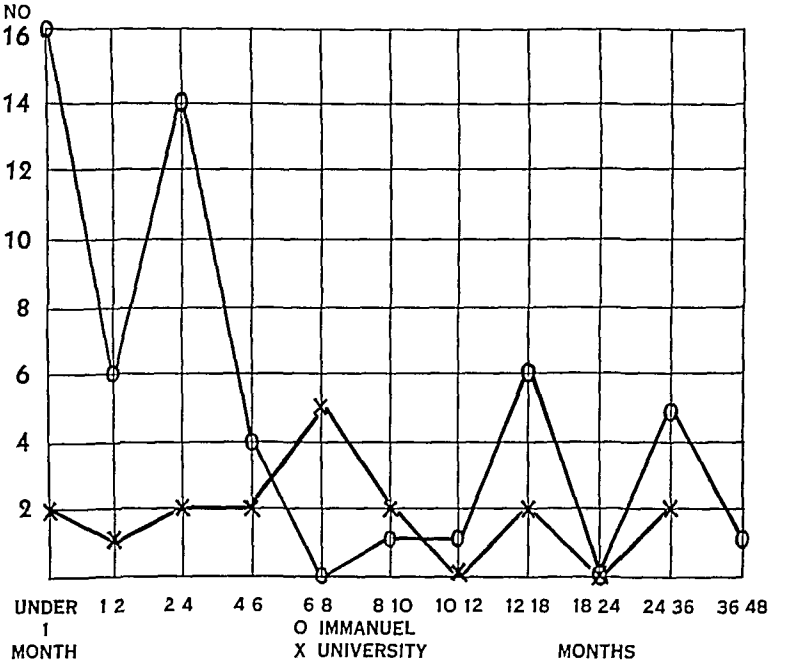


CHART 1 —Showing duration of tumor previous to admission

Chart 2 shows that 75 per cent of the cases still well were operated upon within six months of the onset and 25 per cent between six and 12 months There was not a single cure in cases of one year or over This proves very

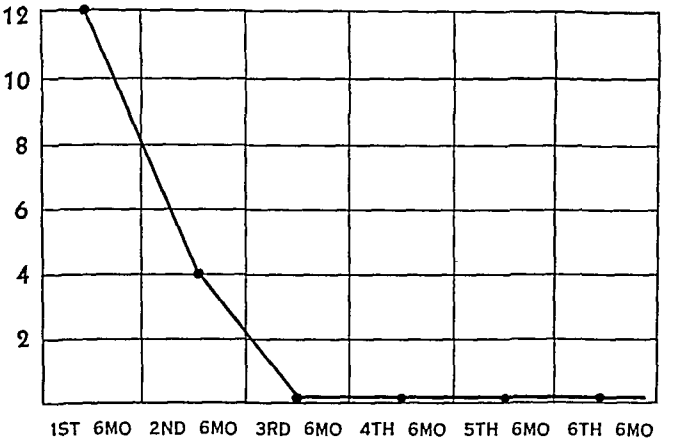


CHART 2 —Shows the precipitant decrease of favorable prognoses predicated upon the duration of the disease previous to admission

conclusively that early diagnosis and treatment are very essential in the cure of carcinoma of the breast The question of the advisability of surgery for cases of long duration is raised

Aside from the duration of disease, a knowledge of the extent of it is im-

portant in determining prognosis For this purpose the following clinical classification is presented

P*1—Early, nonadherent tumor without metastasis
P 2—Tumor adherent to skin or fascia without metastasis
P 3—Tumor with only pectoral node metastasis
P 4—Tumor with general axillary node metastasis
P 5—Tumor involving pectoral fascia with axillary node metastasis
P 6—Large bulky tumor
(a) Without axillary node metastasis
(b) With axillary node metastasis
P 7—Tumor with skin metastasis
P 8—Tumor with bone metastasis
P 9—Tumor with intrathoracic metastasis
P10—Tumor with several types of distant metastases
P11—Bilateral breast tumor
P12—Carcinoma during pregnancy or lactation
R 1—Local recurrence in scar
R 2—Metastasis to skin
R 3—Axillary involvement
R 4—Distant recurrence
(a) Bony
(b) Intrathoracic
(c) Cerebral
(d) Abdominal

*P = Primary R = Recurrent

Of the primary classes, the first six, and possibly the last two, may be operable Class 7 may possibly be made operable by preoperative irradiation Classes 8 to 10 inclusive are distinctly inoperable and palliation only can be considered

TABLE IV

CLINICAL CLASSIFICATION OF BREAST CARCINOMA

	Immanuel	University	Total
P*1	24	1	24
P 2	1	5	6
P 3	9	2	11
P 4	10	4	14
P 5	0	0	0
P 6a	0	0	0
P 6b	5	2	7
P 7	0	1	1
P 8	0	1	1
P 9	0	0	0
P10	1	2	3
P11	0	0	0
P12	1	0	1
Not stated	0	1	1
Totals	51	19	70

* P = Primary

Most of the recurrent cases are inoperable, with the possible exception of those occurring in Class I, *i e*, local recurrence With adequate radical mastectomy this is rare

As the private cases were seen sooner after the onset, the clinical class in general is lower than in the University Hospital cases Forty-four cases, or 86 per cent, of the Immanuel Hospital cases were of one of the first four clinical classes, while only 12 cases, or 63 per cent, of the University Hospital cases were in these classes

TABLE V

PERCENTAGE OF CURES DEPENDING UPON CLINICAL EXTENT

		Well		Dead		Unknown	
	Total	No	Per Cent	No	Per Cent	No	Per Cent
P 1	25	10	40	10	40	5	20
P 2	6	3	50	3	50	0	0
P 3	11	2	18	6	55	3	27
P 4	14	0	0	13	93	1	7
P 5	0	0	0	0	0	0	0
P 6a	0	0	0	0	0	0	0
P 6b	7	1	14	4	57	2	29
P 7	1	0	0	1	100	0	0
P 8	1	0	0	1	100	0	0
P 9	0	0	0	0	0	0	0
P10	3	0	0	3	100	0	0
P11	1	0	0	1	100	0	0
P12	0	0	0	0	0	0	0
?	1	0	0	0	0	1	100
Totals	70	16	23	42	60	12	17

Table V shows that the cures decrease rapidly when gross metastases are found in the axilla

While Types P1 and P2, which are the cases with no demonstrable axillary metastases, give at least 40 to 50 per cent of cures, even low axillary metastases result in only 18 per cent now reported as well There is only one case now well in which the cancer had spread to the other axillary nodes This raises the question of the advisability of very thorough dissection of the central and infraclavicular groups of axillary nodes lying along the course of the axillary vein If the results are so poor, may it not be better to leave these high axillary nodes and so decrease the number of cases of postoperative swelling of the arm? A larger series of cases would be necessary to decide this question

Histologically I am using the classification of Haagensen It considers (1) The manner of growth of cells, (2) cell morphology, and, (3) the reaction of the stroma In detail it is as follows

TABLE VI

HAAGENSEN'S HISTOLOGIC CLASSIFICATION

Manner of Growth of Cells
- (1) Papillary Origin in a cyst formed in a duct
- (2) Comedo Growth mainly within ducts
- (3) Plexiform Growth in plexiform strands
- (4) Adenoid arrangement of cells

Cell Morphology
- (5) Size of cells
- (6) Size of nuclei
- (7) Variation in size and shape of nuclei
- (8) Hyperchromatism of nuclei
- (9) Number of mitoses
- (10) Secretory activity of cells
- (11) Clearness of cytoplasm

Reaction of Stroma
- (12) Fibrosis
- (13) Hyaline degeneration
- (14) Lymphocytic infiltration
- (15) Gelatinous degeneration
- (16) Invasion of lymphatics

Let us now consider the manner of growth of cells The results in the cases under consideration are as follows

		Well		Dead		Unknown	
	Total	No	%	No	%	No	%
(1) Papillary	2	0	0	2	100	0	0
(2) Comedo	15	5	33	7	47	3	20
(3) Plexiform	37	9	24	22	60	6	16
(4) Adenoid	8	3	38	4	50	1	12
Totals	62	17	27	35	57	10	16

Two died of shock of operation Two died of other disease

Different parts of the same tumor may be of quite different histologic types Even in a single microscopic section there may be several types very distinctly represented In following Haagensen's classification with four types, depending upon manner of growth of cells, we found two distinct types in nine cases, three types in three, and all four types in one case We classified these cases in the prevailing type from the sections studied Therefore, histologic grading is definitely subject to error

How does the growth of cells histologically affect each of these classes?

CLASS PI—EARLY NONADHERENT TUMOR WITHOUT METASTASES

	Total	Well	Dead	Unknown
Papillary	0	0	0	0
Comedo	10	4	3	3
Plexiform	9	3	5	1
Adenoid	3	2	0	1
Not stated	3	1	2	0
Totals	25	10	10	5
Per cent		40%	40%	20%

CLASS P2—TUMOR ADHERENT TO SKIN WITHOUT METASTASES

	Total	Well	Dead	Unknown
Papillary	0	0	0	0
Comedo	1	1	0	0
Plexiform	5	2	3*	0
Adenoid	0	0	0	0
Totals	6	3	3	0
Per cent		50%	50%	

* One was an operative death

CLASS P3—TUMOR WITH ONLY PECTORAL NODE METASTASES

	Total	Well	Dead	Unknown
Papillary	1	0	1*	0
Comedo	1	0	1	0
Plexiform	5	2	1	2
Adenoid	3	0	2†	1
Not stated	1	0	1	0
Totals	11	2	6	3
Per cent		18%	55%	27%

* Had local excision, 1 yr , 9 mos later, radical mastectomy Died 12 yrs after first operation

† One died of cerebral hemorrhage suddenly several years after operation

CLASS P4—TUMOR WITH GENERAL AXILLARY NODE METASTASES

	Total	Well	Dead	Unknown
Papillary	0	0	0	0
Comedo	2	0	2	0
Plexiform	10	0	9*	1
Adenoid	2	0	2	0
Totals	14	0	13	1
Per cent			93%	7%

*(1) One died of shock four days after operation (2) One died of apoplexy 1 yr after operation (3) Had tumor for 2 yrs before operation and died 5⅓ yrs after onset

In Classes 5 and 6a there were no cases

CLASS P6B—LARGE BULKY TUMOR WITH AXILLARY NODE METASTASES

	Total	Well	Dead	Unknown
Papillary	0	0	0	0
Comedo	0	0	0	0
Plexiform	6	1*	3	2
Adenoid	1	0	1†	0
Totals	7	1	4	2
Per cent		14%	57%	29%

* Age 51, tumor 1 yr Very large ulcerating mass with bulky axillary metastases Had considerable adenoid type also Performed simple mastectomy only, postoperative roentgenotherapy Still well 12 yrs after onset

† Died four days postoperative of shock

CLASS P7—TUMOR WITH SKIN METASTASES

One case, 6 mos duration, roentgenotherapy only Died 9 mos from onset No microscopic section

CLASS P8—TUMOR WITH BONE METASTASES

One case, 2 mos duration, roentgenotherapy to spine Died 4 mos after onset No microscopic section

CLASS P10—TUMOR WITH SEVERAL TYPES OF DISTANT METASTASES

	Total	Well	Dead
Papillary	0	0	0
Comedo	0	0	0
Plexiform	1	0	1
Adenoid	0	0	0
No section	2	0	2
Totals	3	0	3
Per cent			100%

CLASS P11—BILATERAL BREAST TUMOR

Case, age 42 Second breast operation—radical mastectomy Five years before had first radical mastectomy of other breast Died 7 yrs after onset

An interesting fact in the above study is that, while both cases of a papillary carcinoma, which is usually considered not highly malignant, died, they each lived a considerable time The case in private practice, age 50, had a tumor for two years before treatment, and it had invaded the pectoral lymph nodes This case lived 12 years The case at the University Hospital, age 55, also had a tumor for two years before treatment with invasion of all the axillary nodes She was given preoperative roentgenotherapy followed by a radical mastectomy She lived 5 1/3 years from the date of onset In both of these cases the ultimate death may be attributed to the delay in institution of treatment This series of cases, again, is too small from which to draw definite conclusions

Using the above classification, Haagensen divided the cases histologically into three grades

(I) When papillary or comedo, when adenoid arrangement of cells was marked, when gelatinous degeneration was present, or if lacking any of these preceding characteristics, when variation in the size and shape of the nuclei was slight and there were but few mitoses

(II) All others

(III) Highly malignant tumors Absence of adenoid arrangement, marked variation in the size and shape of nuclei, and numerous mitotic figures If any two of these three present—Grade 3

What are the results in the various grades in each clinical class considered separately?

CLASS P1—EARLY NONADHERENT TUMOR WITHOUT METASTASES

	Total	Well	Dead	Unknown
Grade 1	11	7	1	3
Grade 2	6	1	3	2
Grade 3	5	1	4	0
Unknown	3	1	2	0
Totals	25	10	10	5
Per cent		40%	40%	20%

CLASS P2—TUMOR ADHERENT TO SKIN WITHOUT METASTASES

	Total	Well	Dead	Unknown
Grade 1	1	1	0	0
Grade 2	3	0	3*	0
Grade 3	2	2	0	0
Totals	6	3	3	0
Per cent		50%	50%	

* One was an operative death

CLASS P3—TUMOR WITH ONLY PECTORAL NODE METASTASES

	Total	Well	Dead	Unknown
Grade 1	5	1	3* †	1
Grade 2	4	1	1	2
Grade 3	1	0	1	0
Not stated	1	0	1	0
Totals	11	2	6	3
Per cent		18%	55%	27%

* Had local excision, 1 yr, 9 mos later, radical mastectomy Died 12 yrs after first operation

† One died of cerebral hemorrhage, suddenly, several years after operation

CLASS P4—TUMOR WITH GENERAL AXILLARY NODE METASTASES

	Total	Well	Dead	Unknown
Grade 1	5	0	5*	0
Grade 2	3	0	3	0
Grade 3	6	0	5	1
Totals	14	0	13	1
Per cent		0%	93%	7%

* Tumor for 2 yrs before operation, died 5⅓ yrs after onset One died of apoplexy 1 yr after operation One died of shock 4 days after operation

CLASS P6B—LARGE BULKY TUMOR WITH AXILLARY NODE METASTASES

	Total	Well	Dead	Unknown
Grade 1	1	0	1*	0
Grade 2	1	0	1	0
Grade 3	5	1	2	2
Totals	7	1	4	2
Per cent		14%	57%	29%

* Died of shock 4 days postoperative

The result of summarizing the statistics noted in the preceding tabulations, relative to the question of grading, is appended

	Total		Well		Dead		Unknown	
	No	Per Cent	No	Per Cent	No	Per Cent	No	Per Cent
Grade 1	23	100	9	39	10	44	4	17
Grade 2	17	100	2	12	11	65	4	23
Grade 3	19	100	4	21	12	63	3	16
Unknown	4	100	1	25	3	75	0	0

It is to be noted that we obtain distinctly better results in Grade 1 than in Grades 2 and 3 Unexpectedly, the results are a little better in Grade 3 than in Grade 2 This would probably not be true for a large series

SUMMARY

(1) A method of study is presented to determine the prognosis in carcinoma of the breast This considers both the clinical extent of the carcinoma and the histologic study

(2) A new clinical classification depending upon the extent of the growth is discussed

(3) The histologic classification of Haagensen is used

(4) This study is based on 75 cases of proved carcinoma of the breast

(5) The most important factors in determining prognosis are delay in institution of treatment and the extent of the disease

(6) The histologic classification seems to be of less importance than the clinical study, but has a definite value

(7) No attempt has been made to determine the value of various forms of treatment

(8) It is realized that this series of cases is quite small It is hoped that this method of study may be adopted at larger clinics so that a greater number of cases may be followed

INTRATRACHEAL SUCTION IN THE MANAGEMENT OF POSTOPERATIVE PULMONARY COMPLICATIONS

CAMERON HAIGHT, M D

ANN ARBOR, MICH

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF MICHIGAN ANN ARBOR MICH

STASIS of secretions within the tracheobronchial tree is an important cause of postoperative pulmonary complications, notably atelectasis, aspiration "pneumonia," suppurative pneumonitis and pulmonary abscess The constant maintenance of adequate intrabronchial drainage is essential in the prevention and treatment of such complications The various measures, such as carbon dioxide inhalations, posture and bronchoscopy, which have previously been advocated as prophylaxis in this regard will be briefly mentioned, because these measures are of importance and also because a combination of several or all of the therapeutic measures is frequently necessary Attention will be particularly called to intratracheal suction by means of a catheter introduced through the nares Its purpose is the same as bronchoscopic aspiration, and it may be used either in preference to bronchoscopy, to supplement bronchoscopy when repeated aspirations are necessary, or as an alternative to bronchoscopy when the latter is not available The term "intratracheal suction" will be used in this article to mean the application of actual suction for the removal of intratracheal or intrabronchial secretions, whether by bronchoscopy or by an intratracheal catheter

The writer's interest in this subject was aroused by the constant necessity of preventing the retention of bronchial secretions in postoperative cases of pulmonary suppuration If adequate drainage of these secretions is not provided, the patient is prone to develop either an extension of the disease or an aspiration pneumonia in previously unaffected portions of either lung To prevent the development of such complications, it is necessary that drainage of the bronchial tree be free at all times When patients are willing to cooperate, and when they are not so ill that they are unable to cooperate, free drainage can be maintained by postural methods, such as the Trendelenburg position, as advocated by Gray,[8] by rolling the patient from side to side as advocated by Sante,[13] by hyperventilation with 15 per cent carbon dioxide inhalations, by sufficient narcotics to control pain and promote effective coughing, and lastly by well directed nursing care, so that patients will be assisted to cough and expectorate freely when necessary In other instances intratracheal suction, either by bronchoscopic aspiration or by an intratracheal catheter, must be employed, occasionally as an emergency measure when patients are literally drowning in their own secretions The results of intratracheal suction have, at times, been dramatic in their suddenness Thus,

Submitted for publication June 24, 1937

patients with tracheal râles prior to the procedure may have been dyspneic and cyanotic and at times unconscious because of anoxemia, in spite of an optimum oxygen supply by intranasal catheter or an oxygen tent Such patients, if a too extensive pneumonic involvement has not already occurred, can be rapidly restored to consciousness, quiet breathing and a normal color, merely by the removal of the obstructing secretions so that a normal airway is provided The methods which have been successfully applied in the postoperative management of thoracic surgery patients have been found to be of equal advantage in the treatment of bronchial stasis occurring in general surgery patients This article is presented primarily because of the wide application of these measures in general surgical cases The treatment of postoperative complications arising from septic and aseptic pulmonary emboli will not be considered, inasmuch as the etiologic factor is quite distinct from the complications which are directly the result of retained bronchial secretions However, when bronchial secretions arise as a result of emboli, their management is the same as when the secretions are due to other causes

Causes of Retained Tracheobronchial Secretions—Troublesome secretions within the tracheobronchial tree after operation may be due to aspiration of oral and pharyngeal secretions, either during or immediately following the operation More often they are actual secretions which have normally formed within the tracheobronchial tree or which have resulted from predisposing causes such as the irritating effect of the anesthetic agent, chronic bronchitis, mild bronchiectasis or other pulmonary or bronchial conditions productive of secretions The stasis of normal secretions is in itself sufficient to produce an inflammatory reaction which results in a bronchial exudate

The retention of secretions may be due to several causes, among them being (1) The inability or unwillingness of the patient to cough and expectorate effectively, (2) the lack of application of helpful measures for aiding cough and expectoration, and (3) improper instruction of the patient regarding the necessity of effective cough and expectoration

The most important causes of the patient's inability to cough effectively are (1) Unconsciousness because of anesthetic agents, such as ether, avertin, sodium amytal and too heavy preoperative and postoperative narcotic doses, (2) unconsciousness because of comatose or semicomatose conditions attributable to the patient's age or general condition, (3) insufficient strength because of the recentness or severity of the operation, (4) ineffectual cough due to pain in the operative wound or resulting from upper abdominal binders which may have been applied too tightly so that effective inspiration is prevented, (5) secretions which are too tenacious to be expelled by an otherwise effective cough, and (6) thoracic operations which have produced excessive flaccidity of the thoracic wall

The postoperative position of the patient before he has regained consciousness from anesthesia is of importance in favoring or preventing the development of postoperative pulmonary complications As the semi-Fowler position favors the gravitation of oral and pharyngeal secretions into the tracheo

bronchial tree and the bases of the lungs, and as it favors stasis of bronchial secretions unless the patient is able to cough effectively, the Trendelenburg position is preferable, unless it is contraindicated because of actual or potential infection within the peritoneal cavity

The constant occurrence of viscid bronchial secretions in cases of atelectasis has been stressed by Lee, Tucker and Clerf[11] in one of the first publications on pulmonary atelectasis Because of the thick, mucoid, tenacious character of this bronchial secretion and the inability or disinclination of the patient to clear this secretion from the bronchi, it accumulates in the deeper portions of the bronchial tree until at some point or points this stream of mucus completely occludes the lumen If this occlusion takes place in small bronchioles, a lobular atelectasis occurs, if in a bronchus leading to one lobe, a lobar atelectasis, and if in a main bronchus of either lung, a massive atelectasis [11] Coryllos[4] believes that great viscosity of the bronchial secretion, so characteristic of bronchial stasis, results from the rapid growth of pneumococci which gives to the bronchial exudate a degree of viscosity sufficient to produce obstruction of small or even larger sized bronchi

The urgent indications for application of measures to clear the tracheobronchial tree are several These indications may consist of a wet but unproductive or incompletely productive cough, tracheal or bronchial râles, rhonchi or wheezes heard with or without the stethoscope, or signs of atelectasis or pneumonia as detected either by physical or roentgenologic examinations With regard to roentgenologic examinations, it is frequently difficult, with a portable roentgenologic unit, to differentiate between a postoperative bronchopneumonia and a lobular atelectasis, due to retained secretions or a mucous plug The clinical picture may aid in the differentiation and, in occasional doubtful cases, it is usually advisable to bronchoscope the patient to be certain that a condition which can be relieved by bronchoscopy is not being overlooked

Prevention of Retained Secretions—Several of the methods of prevention of postoperative pulmonary complications have been briefly mentioned These will be more fully discussed and additional measures will be mentioned Preoperatively, it is obviously advisable that a dental prophylaxis be given when indicated and when the operation is not one of emergency Should the patient have a small amount of sputum, he should be encouraged to clear the tracheobronchial tree thoroughly before operation In many cases of pulmonary diseases, it is necessary to employ a postural drainage for this purpose

When anesthesia is complicated by excessive pharyngeal secretions, it is preferable that the operation be carried out with the patient in the Trendelenburg position when possible Should it be known that numerous secretions are being aspirated into the trachea during operation, it may be advisable for the anesthetist to insert a large intratracheal catheter and to administer the anesthetic agent through this catheter Periodic aspirations by the insertion of a smaller catheter through the larger one can then be carried out during the course of the operation In other instances of aspirated secretions in

which it is not necessary to resort to the intratracheal method of administration of anesthesia, it may be advisable to bronchoscope the patient immediately after operation, should an avertin or ether anesthesia prevent him from awakening immediately on completion of the operation As anesthetic agents which produce a long period of unconsciousness after operation are highly conducive to the development of postoperative complications, it is preferable that other agents, which allow the patient to awaken promptly after operation, should be employed if they provide an equally satisfactory anesthesia When the patient awakens immediately after the operation, the anesthetist should, habitually, instruct the patient to cough and clear the tracheobronchial tree as thoroughly as possible

Postoperatively, the use of the Trendelenburg position[1] is of importance This position should be maintained until the patient regains consciousness and it is preferable to maintain it for at least 24 hours, as suggested by Gray Should a patient raise considerable sputum after operation, it may be advisable for this position to be continued for an even longer period Many patients, however, are able to cough more effectively when they are in the semi-Fowler position than when they are in the Trendelenburg position Therefore, if the patient is conscious, the particular position which is best suited to the individual patient should be employed

Coughing and expectoration can be aided when the patient is in the Trendelenburg position by having him lie on one side for fifteen or more minutes and then on the other side in order to allow alternate clearing of the uppermost lung The lateral position also favors the ciliary drainage of secretions from the uppermost lung If one lung is known to be, or to have been, the site of an atelectasis, suppurative pneumonitis, bronchiectasis or bronchopneumonia, this lung is kept uppermost for approximately twice as long as the contralateral lung When the patient is conscious and has no bronchial secretions, it is permissible to allow him to assume the dorsal recumbent position, but even under these circumstances, it is advisable to change to the lateral position from time to time to prevent hypoventilation of the bases of the lungs

The routine use of 15 per cent carbon dioxide and 85 per cent oxygen inhalations every two, three or four hours, followed after each inhalation by voluntary assisted cough, is advocated as a prophylactic measure even when secretions are not present When secretions are present, drainage is facilitated by the administration of carbon dioxide immediately after changing the patient to the lateral position The carbon dioxide should be so administered that it will cause hyperventilation, and again the patient should be encouraged to cough and expectorate after each administration Not only does the hyperventilation tend to clear the tracheobronchial tree by means of the increased inflow and outflow of air, but the carbon dioxide specifically produces relaxation of the bronchial musculature[2] and consequent enlargement of the lumen of the bronchi which facilitate the dislodgment of obstructing secretions Coryllos[4] is of the opinion that, under the influence of carbon dioxide, the

bronchial exudate tends to lose its viscosity and to become transformed into a thin frothy secretion A word of caution might be mentioned regarding the use of carbon dioxide inhalations, if they are given when the patient is in an improper position and are not followed by voluntary cough For instance, as Lubin[12] has stated, when patients with a lower lobe atelectasis are given carbon dioxide inhalations in the upright position without subsequent appropriate postural changes, the secretions already present in the lower bronchial stems will gravitate more deeply into the lower lobes This is particularly true when the secretions are thin

When the patient is instructed to cough, it is frequently advisable for the nurse to assist in the procedure by supporting painful wounds, such as an upper abdominal incision, by means of gentle pressure with a hand on each side of the abdomen so that less tension is placed upon the incision during the cough If the necessity of effective coughing is explained to the patient, he will usually cooperate more fully than otherwise, even when coughing is accompanied by considerable pain

The judicious use of narcotics to prevent excessive pain during coughing is of importance, and the patient should be especially encouraged to cough as soon as each individual dose of the narcotic has produced its maximum effect Care should be taken that the amount of the narcotic should not be sufficient to abolish the cough reflex or to cause prolonged periods of sleep or drowsiness when secretions are present Steam inhalations with the addition of menthol, and one of the many expectorants may be advantageously employed when the secretions are excessively tenacious Atropine should not be used to "dry up" the secretions, as it will only cause bronchial secretions to become thicker than otherwise and drainage will be less efficient

It may be imagined, from the stress that has been placed upon the necessity for adequate cough and expectoration, that patients are considerably exhausted by the procedure Such is not the case, and it should be realized that a few timely and effective coughs at periodic intervals are much less tiring than the more or less constant, irritative and ineffective type of cough which occurs when tracheobronchial secretions are being retained The ineffective type of cough is particularly wearing on a patient and it is also objectionable because it tends to force the secretions farther out into the bronchial tree and parenchyma

Indications for Intratracheal Suction—As careful attention in carrying out the details of the above mentioned measures usually suffices to provide adequate drainage of the bronchial tree, intratracheal suction is usually unnecessary Intratracheal suction is indicated, however, when the cough remains wet and unproductive, either because the patient is unable to cooperate, due to insufficient strength or unconsciousness, or rarely because of unwillingness to cooperate The significance of a wet unproductive cough should not be underestimated, in that it is a most important sign which indicates that secretions are still present and are not being effectively expectorated When the patient is unconscious, one cannot always rely on this sign, as coughing

may be absent unless the cough reflex is provoked, as by aspiration of the pharynx In the unconscious patient, therefore, the diagnosis of retained secretions can at times be made only by auscultation of the chest, in order to determine if rhonchi, wheezes or a wet type of breathing is present, or by listening for these signs with the stethoscope placed in front of the patient's mouth More often, when retained secretions are present in an unconscious patient, tracheal râles and noisy respirations are audible when the listener stands a considerable distance from the patient's bed The diagnosis of retained secretions is then obvious The presence of cyanosis in a conscious or unconscious patient is suggestive of an impaired respiratory pathway when the cyanosis cannot be explained by other causes

It is impossible to be dogmatic about the relative indications for bronchoscopic aspiration or aspiration with an intratracheal catheter Both methods have a place Frequently they can be used interchangeably and it is often a matter of election as to which should be used The writer uses both methods and has no strong preference for either one When a single aspiration will probably be sufficient, bronchoscopy may be preferred, in that it is the more certain of the two methods as it provides actual inspection of the interior of the tracheobronchial tree Bronchoscopy thereby enables the surgeon to be certain that complete evacuation of secretions has been obtained and that a mucous plug has not been overlooked For the same reason, bronchoscopy is probably preferable when a definite atelectasis is present Bronchoscopy also allows the swollen inflamed mucosa to be shrunken with applications of a solution of equal parts of 1-1000 adrenalin and 10 per cent cocaine However, bronchoscopy may possibly cause a greater degree of trauma to the tracheal and bronchial mucosa and thereby cause the further formation of secretions This is undoubtedly of importance in some unconscious patients for whom it is necessary to resort to intratracheal suction every four or six hours in order to maintain adequate drainage In such cases, the intratracheal catheter is the preferable method, although it may be advisable to carry out a bronchoscopic aspiration as the initial procedure In most cases in which intratracheal suction is necessary, a single aspiration or several aspirations with the intratracheal catheter will suffice, and it is then unnecessary to resort to bronchoscopy As bronchoscopy is more strenuous for a critically ill patient, intratracheal catheter suction is the preferable procedure in such instances The deciding criterion may be the method which is the more quickly available It is not unusual that an aspirating machine is already at hand to allow the nurse to remove pharyngeal secretions, and as a sterile No 16 French soft rubber urethral catheter is usually present on the catheterization tray, the catheter method of suction can be employed without delay This method is especially advantageous at night, when a delay in assembling the bronchoscopic equipment may be unavoidable, and also in instances in which a bronchoscopist is not available

Method for Use of the Intratracheal Catheter —An ordinary No 16 French soft rubber urethral catheter, or preferably a Robinson urethral

catheter of similiar size which differs in that it has a double instead of a single opening, is connected to the suction machine with a glass connecting tube and a fairly stiff long rubber connecting tube The catheter should be relatively new so that it will not have become unduly softened by repeated sterilizations It is introduced into the nares and is directed posteriorly until it can be felt to touch the arytenoids The presence of the catheter at this level usually stimulates the cough reflex The catheter is then withdrawn slightly and is next quickly advanced into the trachea simultaneous with the expiratory phase of the cough or during the deep inspiration which follows it If the patient tends to swallow the catheter due to an inactive cough reflex, this can be prevented by slightly withdrawing and advancing the catheter several times in quick succession, in order to stimulate the cough reflex Should the cough reflex still be absent, as occasionally occurs in deeply unconscious patients, it can as a rule be stimulated by carrying out the above maneuver with the suction turned on The introduction of the catheter into the esophagus can usually be avoided if the surgeon remembers to advance the catheter during the expiratory phase of the cough, for the obvious reason that a person cannot swallow and cough at the same time

When the diagnosis of retained secretions has been accurately made, a considerable amount of thick, tenacious purulent secretion will usually be obtained as soon as the catheter enters the trachea The amount of secretion obtained is frequently surprisingly large Furthermore, the presence of the catheter in the trachea incites further coughing which in turn dislodges bronchial secretions into the trachea where they can be removed by suction The procedure so far is carried out with the patient in the recumbent position and with the foot of the bed elevated After the trachea has been cleared, the catheter is introduced farther so that it enters the primary bronchi When the patient is recumbent the catheter usually enters the right stem bronchus, it is usually advisable to turn the patient on the left side in order to introduce the cathether into the left stem bronchus The smaller bronchi are not aspirated, but the forceful coughing which accompanies the procedure tends to expel their secretions into the main bronchi or trachea where they can be aspirated The removal of secretions from the smaller bronchi can be aided by turning the patient from side to side, once or twice during aspiration of the stem bronchi, so that posture will aid the cough in dislodging the secretions from the smaller bronchi The foot of the bed, meanwhile, is kept elevated When the catheter has been advanced well into the stem bronchus, the outer end of the catheter will be found to be within three or four inches of the nose The aspiration is continued usually for one or two minutes, depending on the amount of secretions present, and until no further purulent material is seen coming through the glass connecting tube

The secretions obtained by intratracheal suction are quite thick and tend to plug the catheter and rubber connecting tube In spite of this, it is usually possible to keep the aspirating system clear by rapidly pinching and

releasing either the connecting tube or the catheter in order to cause a sudden stoppage and reapplication of the suction If the system becomes plugged and the above maneuver does not suffice, the glass connecting tube is disconnected from the catheter, so that sterile water can be sucked through the glass and rubber connecting tubes to reestablish their patency If, after reconnecting the system, the catheter itself is found to be plugged, it is necessary to remove it temporarily so that it likewise can be cleared As the suction tends to provoke excessive coughing and slight cyanosis, it is usually necessary to apply suction intermittently by repeatedly pinching the catheter for a period of several respiratory phases from time to time, so that the patient will not be too much upset by the procedure

A reaccumulation or reformation of secretions is to be expected, even though the bronchial tree has been completely cleared of secretions at the first aspiration The patient's condition will frequently have improved sufficiently following one or two aspirations so that pulmonary aeration, voluntary cough and expectoration will subsequently be sufficient to keep the tracheobronchial tree clear In occasional instances it may be necessary to repeat the aspirations at intervals of four, five or six hours over a period of one or more days until the patient is able voluntarily to cough and expectorate effectively The insertion of the catheter causes a mild degree of trauma to the lower pharynx, larynx and tracheobronchial tree and therefore it is unwise to employ the procedure more often than is actually necessary Furthermore, the insertion of the catheter has the theoretical objection of contaminating the bronchial tree with pharyngeal organisms Clinically we have seen no ill effects from this

The number of cases in which intratracheal suction has had to be employed at the University of Michigan Hospital has been relatively few, but the various types of cases in which it has been used have been diversified These postoperative conditions have included partial gastrectomy, cholecystectomy, thyroidectomy, prostatectomy, splanchnicectomy and osteoplastic bone flaps as well as postoperative pulmonary cases The thoracic and postoperative abdominal conditions, especially those with an upper abdominal incision, are prone to develop retained secretions because of pain on coughing The temporary unconscious states that may result from intracranial operations and operations on the urinary tract in the presence of uremia, have also been found to favor the retention of secretions

ILLUSTRATIVE CASE REPORT

Case Report—A male, age 58, had had a slight chronic cough which was productive of a small amount of greenish and occasionally foul sputum On admission the amount of sputum varied between 3 and 34 Gm daily Occasional râles were noted at the base of the left lung and over the right middle lobe A roentgenogram (Fig 1A) showed pulmonary emphysema and increased bronchovascular markings at both bases, more so on the left side

Operation—October 22, 1936 Under nitrous oxide and oxygen anesthesia, a large carcinoma involving the pylorus and lower portion of the stomach was found A resec-

tion of the lower two-thirds of the stomach and a Polya type of gastro-enterostomy were performed The patient's convalescence was satisfactory until the evening of the tenth postoperative day when a disruption of the wound occurred A secondary closure of the wound was promptly effected under light nitrous oxygen anesthesia The duration of the anesthesia was 20 minutes and the patient reacted promptly He was inadvisedly placed

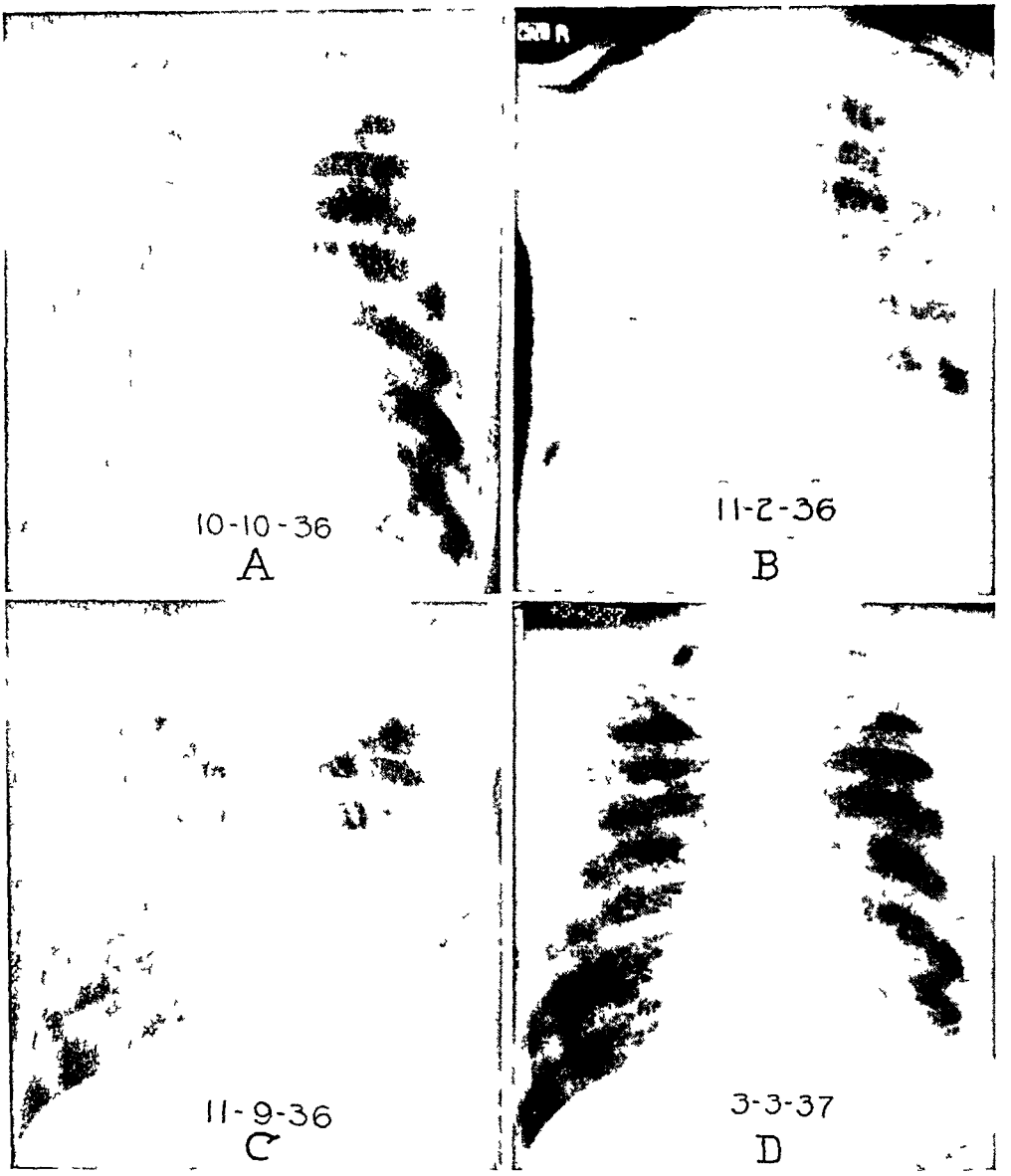


FIG 1.—(A) Preoperative roentgenogram October 10 1936, showing bilateral pulmonary emphysema The increased bronchovascular markings in both bases especially the left suggest a chronic basilar pneumonitis with probable slight bronchiectasis

(B) Portable roentgenogram November 2 1936 three and one half hours after the development of coma and one and one half hours after intratracheal suction was instituted Consciousness had returned at the time this roentgenogram was made An extensive pneumonic involvement has occurred throughout the right lung and in scattered areas in the left lung

(C) Roentgenogram November 9 1936 showing that a marked clearing of the pneumonitis in the right lung has occurred but much residual parenchymal infiltration remains in both upper pulmonary fields especially the right The left costophrenic pleuritis is evident

(D) Roentgenogram March 3 1937 showing a further improvement of the pneumonitis There is a parenchymal scarring on the left and a slight diffuse interstitial pneumonitis in the right upper lobe The left costophrenic pleuritis is essentially unchanged

in the semi-Fowler position, and carbon dioxide inhalations and assisted cough and expectoration were unintentionally omitted His condition was apparently satisfactory until early the following morning The nurse's note states that at 6 A M a "large amount of mucus was present in the throat" About 7 A M the patient became suddenly dyspneic and comatose, the pulse was rapid and thready, the blood pressure dropped to 60/40, and the skin was cold Intravenous fluids (gum acacia, and 5 per cent glucose) and ephedrine were immediately given to combat shock, and the patient was placed in an oxygen tent The flow of oxygen into the tent was at the rate of eight liters per minute

When he was seen by the writer in consultation shortly afterwards, the patient was still unconscious Tracheal rales were audible at a considerable distance, numerous rhonchi could be heard in both lungs and the patient was deeply cyanotic in spite of the oxygen It was obvious that he was drowning in his bronchial secretions An intratracheal catheter was quickly introduced according to the technic described above and a tremenduous amount of thick, purulent secretion was removed The aspiration was carried out with the patient in the Trendelenburg position, and he was turned first on one side and then on the other to allow the removal of secretions from both bronchial trees Consciousness returned about 15 minutes later, and, shortly thereafter, a roentgenogram was taken with a portable unit (Fig 1B) The patient's condition improved rapidly, being aided by a blood transfusion However, he did not regain sufficient strength to cough effectively and a "wet cough" persisted It was, therefore, necessary to continue intratracheal suction every two hours for the following 24 hours and every four hours for the next two days At each aspiration 10 to 30 cc of purulent material was removed The catheter was introduced with the patient in the recumbent position and he was rolled from one side to the other during each aspiration Between aspirations he was changed from one lateral position to the other Because of the greater pneumonic involvement of the right lung, this side was kept uppermost for approximately twice as long (one hour) as the contralateral side (one-half hour) so that drainage from the right lung would be facilitated The foot of the bed was elevated for the first 24 hours and the oxygen tent was kept in place for 48 hours Voluntary cough became progressively more productive, beginning on the afternoon of the first postoperative day, but as the patient's strength had been so exhausted by the second operation, and by the critical complication which followed it, the cough effort did not become completely effective until the third postoperative day when intratracheal suction was discontinued A roentgenogram (Fig 1C) on the eighth postoperative day showed marked clearing of the pneumonitis in the right lung and a small left pleural effusion The patient was discharged from the hospital 26 days after the secondary closure of the wound

He returned for examination two and one-half months later, at which time further improvement of the pneumonitis was evident (Fig 1D) The minimal left pleural effusion had remained sterile and relatively unchanged in amount during the interval

This case is presented to illustrate the relief of an apparently hopeless complication by the use of intratracheal suction

SUMMARY AND CONCLUSIONS

The constant maintenance of adequate drainage of the tracheobronchial tree is essential in the prevention and effective treatment of postoperative pulmonary complications Many of the so-called postoperative pneumonias are due to the aspiration of pharyngeal secretions or to the retention of tracheal or bronchial secretions Postoperative complications in such instances can usually be avoided by keeping the tracheobronchial tree constantly

free of secretions Such measures as posture, carbon dioxide inhalations, assisted cough and expectoration and the use of narcotics, inhalations and expectorants have been discussed The indications for intratracheal suction, which is employed by means of bronchoscopy or by an intratracheal catheter introduced through the nares, have been described Particular attention has been called to the advantages and the method of use of the intratracheal catheter Although it is not always possible to prevent the development of postoperative pulmonary complications, it is believed that the incidence and the severity of such complications can be greatly minimized by following out the preventive and therapeutic measures described

REFERENCES

[1] Boulant and Cheret Cited by Corvllos [4]

[2] Brown, A L Bronchoscopic Observations in Postoperative Atelectasis Action of Carbon Dioxide J A M A, 95, 100, July 12, 1930

[3] Brunn, H, and Brill, S Observations on Postoperative Pulmonary Atelectasis Consideration of Some Factors in Its Etiology, Prevention and Treatment ANNALS OF SURGERY, 92, 801, November, 1930

[4] Corvllos, P N Postoperative Pulmonary Complications and Bronchial Obstruction Surg, Gynec, and Obstet, 50, 795, 1930

[5] Corvllos, P N, and Birnbaum, G L Syndrome of Pneumococcic Bronchial Obstruction Experimental Production of Atelectasis or Lobar Pneumonia with Human Pneumonic Sputum, Suggestions for Prevention and Therapeutic Treatment Arch Int Med, 51, 290, 1933

[6] Faulkner, W B, Jr Internal Drainage, Its Application in Pulmonary Suppuration J A M A, 95, 1325, November 1, 1930

[7] Faulkner, W B, Jr, and Faulkner, E C Internal Drainage A Causative Factor in the Production of Postoperative Massive Collapse of the Lung (Pulmonary Atelectasis) Suggestions as to Prevention and Treatment Act Chir Scandinav, 69, 105, 1932

[8] Gray, H K Postoperative Pulmonary Complications and Postoperative Use of the Trendelenburg Position Minn Med, 18, 273, May, 1935

[9] Harrington, S W Relief of Postoperative Massive Collapse of the Lung by Bronchoscopy ANNALS OF SURGERY, 85, 152, 1927

[10] Jackson, C, and Lee, W E Acute Massive Collapse of the Lungs ANNALS OF SURGERY, 82, 364, September, 1925

[11] Lee, W E, Tucker, G, and Clerf, L Postoperative Pulmonary Atelectasis ANNALS OF SURGERY, 88, 6, July, 1928

[12] Lubin, M L Internal Drainage Its Significance in the Prevention and Treatment of Postoperative Pulmonary Atelectasis Am Jour Surg, 19, 80, January, 1933

[13] Sante, L Massive Atelectasis of the Lung ANNALS OF SURGERY, 85, 608, 1927, J A M A, 88, 1539, 1927

[14] Thompson, S A Bronchial Catheterization Am Jour Surg, 31, 260, February, 1936

[15] Tucker, G Bronchoscopic Observations on Obstructive Atelectasis Arch Otolaryngol, 13, 315, 1931

[16] Van Allen, C M, and Lindskog, G E Obstructive Pulmonary Atelectasis Arch Surg, 21, Part II, 1195–1213, December, 1930

SPONTANEOUS CHOLEDOCHOGASTROSTOMY AND CHOLECYSTOGASTROSTOMY

MARSHALL DAVISON, B S, M D, AND LEON J ARIES, M S, M D
CHICAGO, ILL

FROM THE DEPARTMENT OF SURGERY, NORTHWESTERN UNIVERSITY MEDICAL SCHOOL AND THE SURGICAL SERVICE OF MARSHALL DAVISON, COOK COUNTY HOSPITAL, CHICAGO ILL

THE observation of an instance of spontaneous anastomosis between the short proximal end of a traumatically severed strictured common bile duct and the pylorus of the stomach, and two cases of spontaneous cholecystogastrostomy, is unusual

Benign strictures of the bile ducts may result from inflammatory processes and occasionally from the passage of gallstones, but injury to the common duct from operative trauma is the more common etiology Previous to 1914, benign strictures of the common duct were infrequent and were recorded individually This was probably due to the fact that cholecystostomy was the operation of choice rather than cholecystectomy or common duct drainage Since that time a tremendous literature has developed on the reconstructive surgery of the extrahepatic bile ducts This is not only the result of forward steps in reparative surgery, but is also due to advances in the technic of operating upon malignant lesions

The first cholecysto-enterostomy was reported, in 1882, by Winiwarter In 1892, Doyen performed an end-to-end anastomosis of the common duct Murphy,[7] in 1892, performed a cholecystoduodenostomy employing the Murphy button, with an excellent result Jenckle reported a case in which he performed a hepaticocholangiogastrostomy, but the result was not recorded Various types of anastomoses between the common duct and the stomach, duodenum, small bowel, or colon have been advanced However, we have been able to collect only seven cases of *spontaneous* internal biliary fistula in 6,000 autopsies at the Cook County Hospital One was due to perforation of a carcinoma, and one to perforation of an ulcer of the stomach The remaining five were the result of perforation of stones into the duodenum In none of the cases was the condition diagnosed during life, but was recorded incidentally at autopsy, with the exception that gallbladder histories were obtained in three cases, and stones were demonstrated clinically in two

Judd and Burden[4] have reported 153 cases of spontaneous internal biliary fistulae which required operative relief, but were able to diagnose the condition preoperatively in only two instances They believe that the presence of a fistula is a complication rather than a cure of the preexistent pathology The presence of a fistula with adequate drainage becomes complicated only as time passes, when the tract becomes progressively shrunken in caliber due to the

Submitted for publication December 4, 1936

presence of active infection or to latent cicatrization Pohlandt[9] demonstrated such a spontaneous cholecystogastrostomy by using a thin mixture of barium orally, followed by the injection of air into the stomach He states that in such cases the bile passages are occasionally outlined by taking a flat roentgenogram of the abdomen, and that air can be demonstrated in the gallbladder and ducts if a fistula exists This procedure was tried in our case without success, probably because the fistulous opening was too small

Forty-four cases of internal biliary fistula have been diagnosed preoperatively, according to Candel and Wolfson, who demonstrated a cholecystocolostomy by the presence of air in the bile passages It is difficult to demonstrate choledochogastric fistulae by such an opaque medium as lipiodol, since the stomach cannot be filled under pressure We have used 7 per cent sodium bromide solution as a contrast medium, from which there was no ill effect

Methods of Corrective Anastomosis In instances in which the diagnosis of a choledochogastric or intestinal fistula has been made preoperatively, or in which the condition is found unexpectedly at operation, certain prosthetic measures may occasionally be employed

When insufficient or no common duct remains, one of several procedures may be possible The rubber tube is employed most widely[2], one end may be placed in the duct and the other into the stomach or duodenum,[1] eventually passing spontaneously into the bowel A modification of this method has been suggested by Hoche,[3] in which the tube, placed into the duodenum, has several openings in its wall, allowing bile to escape into the duodenum, the distal end of the tube is brought out through the abdominal wall from a point lower in the duodenum, so that the tube may be withdrawn externally after several weeks, and the residual duodenal fistula allowed to close This method, however, occasionally results in a persistent duodenal fistula The tube must have a large lumen to prevent the precipitation of bile salts and pigments and thus block the biliary tree Tubes may pass into the bowel before the duct heals and thus predispose to stricture formation Absorbable tubes of gelatin, and more recently absorbable tubes of magnesium,[8] have served as prostheses Williams, in 1914, used the fistulous tract, formed by the drainage of the common duct to the anterior abdominal wall, for transplantation into the duodenum Lahey,[5] Lilienthal,[6] and Walters[12 13] have used these external fistulous tracts in cases where there was little or no common duct present This method does not give uniformly satisfactory results

Experimentally, in dogs, plastic tubular flaps have been taken from the mucosa of the stomach and anastomosed with the gallbladder[10] In reviewing the literature, we find that Stubenrauch,[11] in 1906, used a full-thickness tubular flap of the pylorus of the stomach and anastomosed this to the gallbladder successfully To our knowledge, there have been no other reports of this procedure Gohrbandt[2] has anastomosed the intrahepatic bile duct to the stomach by dilating the duct and using a rubber tube as an intermediary He has also punctured the liver with a trochar, and into this opening has inserted a rubber tube, followed by anastomosis of the liver to the stomach over the tube

Case Reports

Case 1—A white female, age 38, presented herself in March, 1928, with the history of having suffered intermittent pain in the right upper quadrant for three days, which had become progressively worse It radiated to the back and right scapular region, and was followed by nausea, repeated vomiting and jaundice The past history was that of the occurrence of a similar pain in the right upper quadrant of the abdomen every two or three months for the previous year Bed rest and occasional opiates were necessary for relief Selective dyspepsia for fats and fresh fruit was present The patient had had typhoid fever 21 years previously

Physical Examination revealed a fairly well developed white woman who was mildly jaundiced The liver edge was palpable two fingers below the costal margin The gallbladder region was exquisitely tender Gallbladder visualization revealed five opacities present below the transverse process of the second lumbar vertebra, which were interpreted as stones The icteric index was 15 per 100 cc of blood serum and the urine showed bile All other laboratory findings were negative

Operation—April 24, 1928 A transverse subcostal incision was made and a cholecystectomy performed The gallbladder contained 25 stones and was 3 Mm thick Two gauze drains were inserted After the drains were removed, the wound failed to close and continued to drain bile for six weeks Cessation of the drainage was immediately followed by a chill, fever, and progressive jaundice A diagnosis of common duct stone with obstruction and ascending cholangeitis was made

Second Operation—June 28, 1928 An incision was made through the existing transverse subcostal scar The common duct was explored, a stone removed, and a T tube inserted into the duct Drainage was allowed to continue for six weeks

The patient was well for one year, when she returned with symptoms of pain and mild jaundice which were treated conservatively with calomel and magnesium sulfate The attacks were mild in nature but would recur every three or four months in spite of dietary regimen Between these episodes the patient felt comfortable She presented herself to the Gynecologic Department in 1933, at which time a hysterectomy was performed In December, 1934, the patient developed a progressive jaundice associated with severe pruritus

Third Operation—January 11, 1935 After proper preoperative preparation with blood transfusions, glucose, and calcium, a third transcostal incision was made The common duct was dissected out of a mass of adhesions and a benign stricture of it was found, the two-thirds of the duct distal to the stricture was completely obliterated by cicatrization The liver was swollen, a mottled, brownish-green in color, with a rounded edge Since insufficient common duct remained proximal to the stricture into which a T tube could be placed, it was thought best to attempt the formation of an external biliary fistula whose external orifice could later be transplanted into the stomach or duodenum With this in view, a catheter was inserted into the proximal end of the common duct and external drainage was instituted However, notwithstanding the fact that all persons had been instructed as to the dangers of removing the tube, on the sixth postoperative day, an attendant accidentally pulled the catheter out while arranging the bed clothing Since jaundice was expected to return, the patient was kept in the hospital for two months, but although the wound closed within two weeks there was no occurrence of either jaundice or pain The stools were dark greenish-brown in color

The patient left the hospital March 17, 1935, and remained perfectly well for three months, at which time the previous symptoms returned These began as an ache in the right upper quadrant, which radiated to the shoulder and was accompanied by nausea, jaundice, and an unbearable pruritus

Fourth Operation—July 31, 1935 A transverse subcostal incision was made, for the fourth time, through the old scar, and after much difficulty the common duct was

isolated and explored Parenthetically, it is interesting to note that up to this time no herniation had resulted following the repeated use of the transverse subcostal incision The fascial layers were all fused, and the parietal peritoneum was adherent to the anterior surface of the stomach and transverse colon After freeing the adhesions and dissecting down to the region of the common duct, it was only possible to identify the duct by needle aspiration The stomach was separated with difficulty from the region of the duct, and a fistulous tract was identified extending between the lateral aspect of the proximal end of the common duct and the lesser curvature of the stomach at the pyloric junction (Fig 1)

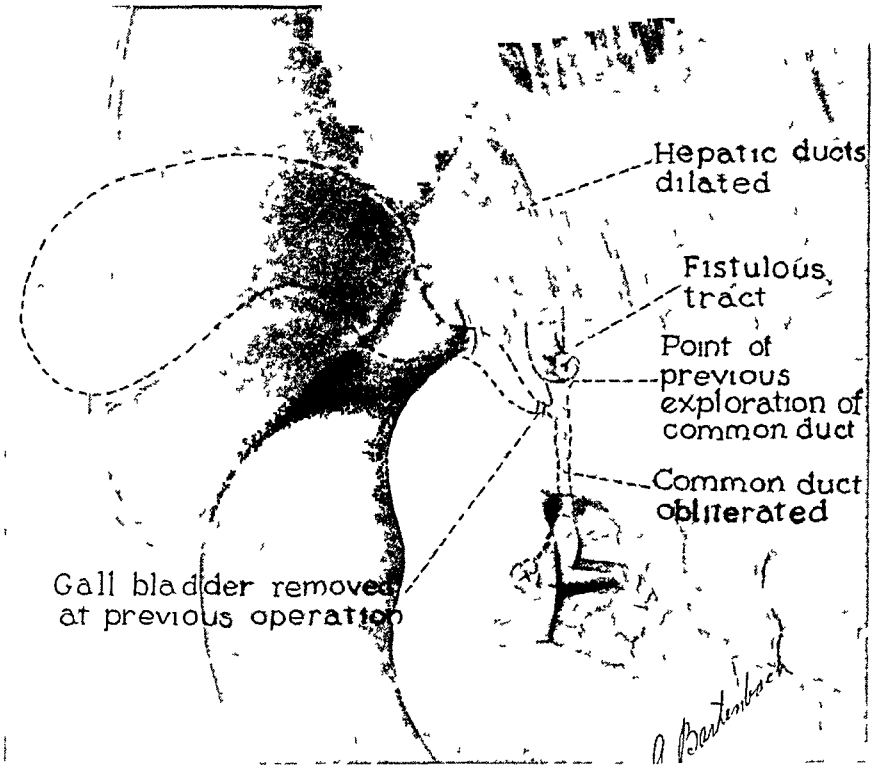


Fig 1 —(Case 1) Spontaneous choledochogastrostomy Illustrating the fistulous communication between the proximal common duct and the stomach The dotted lines indicate the previous position of the gallbladder and common bile duct whose distal portion previously had become obliterated following common duct drainage

It would seem that the lumen of the fistula had originally been sufficiently large to carry the bile into the stomach, but after four months the lumen had become so small that jaundice supervened It is difficult to explain the mechanism of this fistulous tract, which formed without any underlying prosthesis or the ulceration of a stone, and within a very short period of time The gastric fistula was closed by imbrication, and a Y tube was placed into the right and left hepatic ducts with the hope of forming an external fistulous tract that could subsequently be implanted into the duodenum The patient had an uneventful postoperative course The jaundice disappeared rapidly, but the icteric index remained elevated for six weeks

Subsequent infrequent obstructions of the drainage tube would cause back pain that would radiate to the shoulder This we ascribed to increase of the intrahepatic pressure following the period of inadequate drainage Radiopaque material injected into the biliary tree revealed the Y tube to be in place However, in November, 1935, the tube became obstructed, and was spontaneously extruded from the fistulous tract, drainage rapidly ceased and jaundice developed During the following month the jaun-

dice, however, gradually disappeared, and it was inferred that another anastomosis had formed spontaneously between the common duct and the stomach

The patient again presented herself in February, 1936, complaining of abdominal pain, intermittent jaundice, clay-colored stools, and pruritus She continued to lose weight and strength, so that some type of reconstructive anastomosis between the remainder of the common duct and the gastro-intestinal tract appeared to be imperative Previously, we had outlined a plan of forming a tubular flap from the stomach to anastomose with the proximal common duct as described by Stubenrauch

Fifth Operation—February 10, 1936 For the fifth time, a transverse subcostal incision was made through the old scar, through which, however, at this time a small hernia had developed The stomach was found intimately adherent to the undersurface of the liver, by sharp dissection a fistulous communication was exposed between the stomach and the common hepatic duct at its point of emergence from the body of

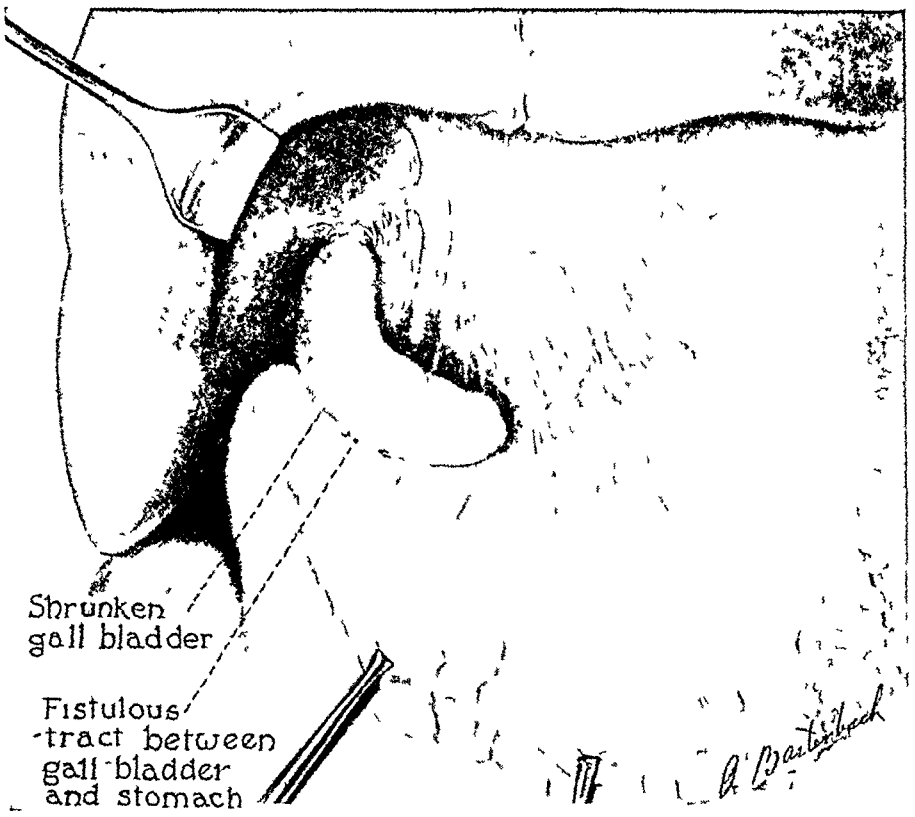


FIG 2—(Case 2) Spontaneous cholecystogastrostomy Illustrating the fistulous communication between the gallbladder and the stomach, probably at the site of perforation of a previously existent stone

the liver Since there was no extrahepatic portion of the common duct remaining, it was technically impossible to perform an anastomosis between it and the stomach As a procedure of necessity, one arm of a T tube was inserted into the intrahepatic portion of the hepatic duct and the other arm introduced into the stomach The long end of the tube was brought out of the lateral margin of the abdominal wound The wall of the stomach was inverted around the intragastric portion of the tube, and the opposed surface sutured to the liver capsule at the T junction of the tube to prevent leakage and to reduce the possibility of later scar contraction diminishing the patency of the fistula Bile began to drain through the long arm of the T tube, and the stools became greenish in color The collected bile was dark, viscid, and cloudy, and for this reason it was not reinjected After eating, the patient complained of pain in the right upper quadrant, however, by allowing the long arm of

the T tube to remain open for two hours after meals, stomach contents regurgitating into the T tube did not obstruct the biliary drainage and the symptoms were relieved The patient is well and gaining weight at the present time, eight months following the last operation, and eight years after her initial complication

Case 2—S G The history obtained through an interpreter was that of pain in the right upper quadrant of the abdomen of two weeks' duration, radiating to the right shoulder, accompanied by vomiting The past history was negative except for an occasional chill followed by fever during the past two years, which the patient attributed to colds She had had five children

Physical Examination revealed a thin female with abdominal tenderness localized to the right upper quadrant of the abdomen The gallbladder could not be visualized on two occasions A flat roentgenogram of the abdomen revealed no shadows suggestive of stones The urine contained a trace of albumin Cystoscopy and pyelography revealed no lesion of the urinary tract White blood count, 7,300, Wassermann reaction, negative

Operation—September 11, 1935 A transverse subcostal incision was made, and a chronic phlegmonous cholecystitis with secondary cicatrization and shrinkage of the gallbladder was found There were old, dense adhesions between the gallbladder and the stomach Dissection at the point of apposition between the pylorus and the midportion of the gallbladder demonstrated a spontaneous fistula to exist between these two structures (Fig 2) There was no evidence of ulcer in the stomach The proximal common bile duct was dilated, the liver enlarged and discolored, its edge was rounded, and extended three fingers breadth below the costal margin There were no stones in either the common duct or gallbladder After liberating the fistula and imbricating the opening into the stomach, a cholecystectomy was performed

Postoperative Course—An uneventful convalescence ensued At a subsequent examination, three months later, she did not complain of any symptoms

This patient probably had passed stones into the stomach through the spontaneous cholecystogastrostomy, the dilatation of the common duct was no doubt due to the small caliber of the fistulous opening

Benign biliary fistula into the gastro-intestinal tract may exist unrecognized, and without symptoms, until the fistulous tract becomes narrowed by cicatrization or inflammatory change to an extent sufficient to produce obstructive jaundice If sufficient infection is present in the retained bile, liver abscesses with a septic syndrome may develop

Case 3—For nine years the patient, a white female, age 46, had suffered from intermittent attacks of pain in the right upper quadrant of the abdomen These pains were sharp, radiated to the right shoulder and around the right costal margin to the back, but were never associated with vomiting, jaundice, or clay-colored stools About one week before admission to the hospital she suddenly experienced a chill followed by pain in the right upper quadrant of the abdomen This pain was sharp, burning in character, and radiated to the right shoulder and to the back During the preceding week she had vomited one or two times each day On the second day of the attack she had noticed an increasing jaundice with lighter stools and a dark green urine On entrance into the hospital, she appeared acutely ill, slightly irrational, severely jaundiced, and markedly dehydrated The liver edge was palpable, and there was tenderness in the gallbladder region The icteric index was 180, the urine contained considerable bile, the urea nitrogen in the blood was 105 per 100 cc, creatinin, 1 5 mg Her temperature reached 104° F In view of the long history of intermittent attacks of pain in the right upper quadrant, the present attack was interpreted as being due to a stone in the common duct with resultant obstructive jaundice and septic cholangeitis In

spite of active, conservative treatment, the patient apparently developed cholemia and died after five days, 11 days after the onset of the acute attack

Autopsy—Dr Richard H Jaffe The patient was an obese white woman whose skin had a deep yellow color and whose abdomen was slightly distended The liver was markedly swollen and extended for 4 cm below the costal margin, was soft in consistency, and a deep olive-green in color The intrahepatic bile ducts were much dilated and were filled with a thin, dirty-green bile In the right lobe soft confluent bright yellow areas up to 5 Mm in diameter were found The gallbladder was shrunken to about the size of a cherry, and was firmly adherent to the lesser curvature of the stomach At this region the mucosa of the stomach showed a pinhead-sized opening with everted edges, from which a narrow fistulous tract extended into the lumen of the gallbladder The gallbladder contained a small amount of mucopurulent material The hepatic ducts and the common duct were markedly dilated The common duct meas-

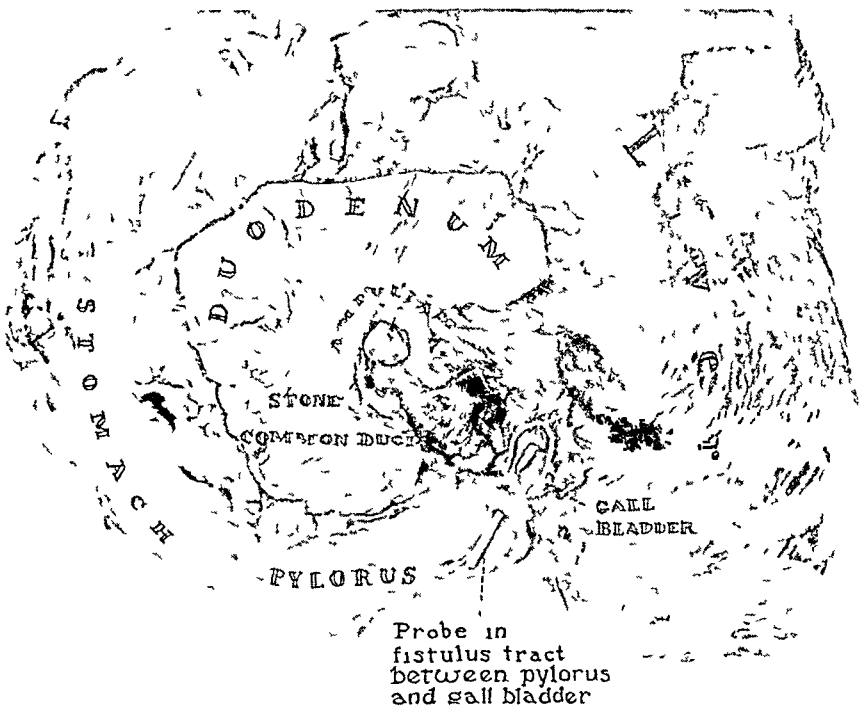


FIG 3—(Case 3) Photograph of the gross specimen of liver stomach, and duodenum showing a facetted stone in the ampulla of Vater with obstruction and marked dilatation of the common bile duct and a spontaneous fistula between the gallbladder and pylorus The gallbladder is shrunken (outlined by white marker) and contains a probe lying in the fistulous tract between the pylorus of the stomach and the gallbladder, probably at the site of passage of a previously existent stone

ured 25 Mm in diameter and within the lumen of the duct, above the opening of the pancreatic duct, a facetted light-brown stone measuring 13 Mm in diameter was present (Fig 3) The cystic duct was tortuous and moderately dilated The pancreatic duct was of normal caliber The pancreas revealed several pinhead-sized opaque, light-yellow areas The other autopsy findings were those usually found in death from septicemia

Anatomic Diagnosis—Obstruction of the common duct by a stone, with marked dilatation of the extra- and intrahepatic bile ducts and ascending cholangeitis, multiple abscesses in the right lobe of the liver, and in both kidneys Chronic cholecystitis with marked shrinkage of the gallbladder Spontaneous cholecystogastrostomy

This case represents one of benign obstruction of the common duct caused by a stone proximal to the ampulla of Vater The stone has caused stagnation

of the biliary flow with subsequent dilatation of the extra- and intrahepatic bile ducts There was only this single stone in the common duct, but since it was facetted, other stones must have been previously present which had left the gallbladder either through the common duct, or through the fistulous tract which connected the gallbladder with the stomach Because of the extreme shrinkage of the gallbladder, this fistulous tract undoubtedly had decreased in size The stasis of bile in the common duct led to an ascending biliary tract infection, and from this infection multiple abscesses developed in the liver, and later, by way of the blood stream, in the kidneys

Two factors are responsible for the patient's death Namely, the severe damage to the liver parenchyma by the long-standing stagnation of the bile flow, and septicemia from the ascending infection of the biliary system As is usual in cases of benign obstruction of the biliary passages, the gallbladder was small and shrunken Since the stone was located proximal to the opening of the pancreatic duct, the pancreas was not affected by the occlusion of the common duct Subterminally a small amount of infected bile had entered the pancreatic duct and had caused multiple foci of fat necrosis

CONCLUSIONS

(1) Benign biliary fistulae into the gastro-intestinal tract may exist unrecognized and without symptoms other than chronic gallbladder disease until the fistulous tract becomes narrowed either by cicatrization or inflammatory change to an extent sufficient to produce obstructive jaundice If sufficient infection is present in the retained bile, ascending biliary tract infection may then occur

(2) There is nothing in the symptomatology in these cases, in which there is an obstructive jaundice clinically, to lead one to suspect the existence of such a fistula

(3) Diagnosis of the condition is theoretically possible, before obstruction occurs, by the roentgenologic finding of injected opaque material or air from the stomach or duodenum in the biliary passages This would no longer be a possible finding after the fistula had become obstructed

(4) Inadequate biliary drainage through a fistulous communication between the common duct and the stomach or duodenum must be recognized as a cause of obstructive jaundice

(5) Since the condition is obviously infrequent, its presence must be taken as a clinical rarity rather than a frequent cause of obstructive jaundice

(6) These cases are mechanically amenable to treatment, but, as is true in all cases of obstructive jaundice, the ultimate prognosis is dependent upon the duration and completeness of the obstruction, and the consequent damage to the liver by back pressure or infection

REFERENCES

[1] Desplas, B Etude anatomique des resultats d'une prosthese par sonde perdue entre le canal hepatique et l'estomac sans suture directe Bull et mem Soc de nat de chir, 57, 770–774, May 30, 1931

[2] Gohrbandt, Erwin Anastomosen intrahepatischer Gallengange mit dem Magen und Darmkanal (unter Benutzung von Gummiprosthesen) Arch f klin Chir, 179, 665–671, 1934

[3] Hoche, Otto Ueber Umgehungs- und plastische Operationen im Bereich der Gallenwege Arch f klin Chir, 176, 622–627, 1933

[4] Judd, E S, and Burden, V G Internal Biliary Fistula ANNALS OF SURGERY, 81, 305–312 1925

[5] Lahey, F H Transplantation of Common Duct Fistula into Duodenum, 2 cases Tr New York Surg Soc, ANNALS OF SURGERY, 67, 765–767, 1923

[6] Lilienthal, Howard Transplantation of Common Duct Fistula into Stomach ANNALS OF SURGERY, 67, 765–767, 1923

[7] Murphy, J B Cholecysto-intestinal, Gastro-intestinal, Entero-intestinal Anastomosis and Approximation without Sutures Med Rec, 42, 665–676, 1892

[8] Pannella, P Cholecystoduodenal Anastomoses with Tubes of Reabsorbable Metal (Magnesium) in Drainage of Bile Ducts Arch et atti d' soc ital de chir, 38, 809–812, 1932

[9] Pohlandt, Klaus Gallenblasen-Magenfistel nach Steindurchbruch Beitr z klin Chir, 159, 138–147, 1934

[10] Schrager, V L, Ivy, A C, and Morgan, J E A Method for the Plastic Reconstruction of the Common Bile Duct Surg, Gynec, and Obstet, 54, 613–619, 1932

[11] Stubenrauch Ueber plastische Anastomosen zwischen Gallenwegen und Magendarmcanal zur Heilung der completen ausseren Gallenfistel Arch f klin Chir, 79, 1015–1030, 1906

[12] Walters, Waltman Strictures of the Common and Hepatic Bile Ducts Surg, Gynec, and Obstet, 48, 305, 1929

[13] Walters, W, Parker, R L, and Nygaard, K K Strictures of the Common Bile Duct Proc Staff Meet, Mayo Clin, 10, 817–820, December 26, 1935

STONES IN THE COMMON BILE DUCT*

FRANK C BEALL, M D
FORT WORTH, TEXAS

THOSE of us who were doing surgery 20 years ago can recall the spirited debates which took place between the proponents of cholecystostomy and cholecystectomy in the treatment of diseases of the gallbladder As I began to replace the routine cholecystostomy with cholecystectomy, I was immediately impressed (and I presume others must have been) with the fact that convalescence after cholecystectomy was usually much smoother and more rapid than after cholecystostomy It might be reasoned that the cause of this is that, with cholecystectomy, the body is relieved at once of a source of toxemia However, I do not believe this is the only reason, nor, indeed, the chief reason I believe it is the effect of the loss of bile from the body that delays the convalescence in many cases of cholecystostomy

That excessive loss of bile from the body is deleterious cannot be denied Hooper and Whipple (quoted by Howell[1]) state that In the dog, complete diversion of the bile to the surface is followed by the death of the animal in less than a month Man seems to be more adaptable Judd[2] has reported two cases of biliary fistula in association with complete stricture of the common bile duct of 12 and 21 months' duration He did not remark on the condition of the patients In his discussion, however, he said "As an adjuvant in cases of chronic biliary fistula, Gerster and Nissen advocated feeding bile collected from the fistula It is well tolerated and the general improvement, when debility and asthenia become marked, is striking" I, myself, have repeatedly seen cases of biliary fistula develop distressing symptoms, usually loss of weight, great weakness, anorexia, nausea, diarrhea, and a weak, rapid pulse, and have seen these symptoms promptly ameliorated by the administration of bile or the bile salts At the present time it is my practice to administer bile salts in all cases where there is any considerable bile drainage

We know that the presence of the bile salts in the intestinal tract is essential for the digestion of fats and believe the bile has other important functions Walters[3] has published the results of some interesting experiments upon the effects of calcium on the coagulability of the blood in the presence of jaundice He found that it took approximately twice as much calcium, given intravenously, to raise the blood calcium in dogs who were jaundiced from ligation of the common duct to the same level as it did in normal dogs, and also that about 50 per cent more calcium was required to kill such a jaundiced dog than was required to kill a normal dog This is evidence that there is a marked deficiency in the body calcium in the presence of obstructive jaundice

* Read before the Texas Surgical Society at San Antonio, Texas, October 10, 1935
Submitted for publication May 8, 1937

Rudolph and Cole (quoted by Walters[3]) claim that the oral administration of calcium has no effect on the coagulability of the blood in jaundiced patients while other observers have reported marked calcium effects in other conditions (pleural effusions, edema, *etc*) from its administration by mouth This would indicate that, in jaundiced patients, the process of calcium absorption is disturbed Cushny (quoted by Walters[3]) says that calcium salts are absorbed with great difficulty from the stomach and intestines and that their absorption is facilitated by the fatty acids, with which they combine to form a soap of calcium, which is more readily taken up by the surface epithelium Herein may lie the explanation of the calcium deficiency which occurs in obstructive jaundice If the bile salts are absent from the intestinal tract there can be no digestion of fats and so no fatty acids, which Cushny seems to think is essential for calcium absorption This would suggest that the administration of bile salts might be helpful in jaundiced patients and that the administration of bile salts and fats might be helpful in any form of oral calcium therapy

The tendency to diarrhea, often of a putrid character, both in cases of obstructive jaundice and in cases of biliary fistula, is well known Howell[1] attempts to explain this diarrhea as being due to an excessive bacterial decomposition of the nitrogenous constituents of the food which become coated by the undigested fats when the bile salts are lacking, and so are insulated from the digestive action of the pancreatic trypsin

Obstruction of the common bile duct, due to the back pressure of the confined bile, causes a dilatation of the biliary tree and an impairment of function or, if the obstruction is of a marked degree, atrophy of the parenchymal cells of the liver In the cases of obstruction from stones there is the added factor of infection Due to the degree and duration of the obstruction and to the severity of the infection, we have all grades of liver damage, from those which are hardly recognizable to the most marked degrees of biliary cirrhosis, the so-called "livers of surgical delay"

In no field of surgery, perhaps, unless it be that which is concerned with the relief of prostatic hypertrophy, is careful preoperative preparation and equally careful postoperative treatment so essential for success as that of the surgery of the bile ducts As I have said, the cases of stone in the common duct may come to us handicapped by any degree of hepatic dysfunction, and many of them also have other serious secondary complications, chiefly pancreatitis and renal insufficiency Many of them present themselves in an acute phase with a highly active cholangeitis[1] or cholecystitis Fortunately, the acute septic conditions which accompany stones in the common duct are prone to be remittent, and so we can usually tide these acute cases over and operate upon them at a more favorable time Rarely an emergency operation, usually drainage of the gallbladder must be performed

The great majority of cases of stone in the common duct are not in need of emergency surgery They need surgery, but they need carefully planned surgery, undertaken at the right time The great value of fluids, sugars,

intravenous calcium and transfusions, both as preoperative and postoperative measures, is too well known to need comment Everything which can be done to build up and conserve the patient's strength should be done There is just one point at which I seem to diverge from generally accepted principles, and that is in regard to drainage of the common duct after the removal of stones

Why drain the common duct? In the great majority of cases I think it is entirely unnecessary I can urge against it, my belief that an excessive loss of bile from the body may have deleterious effects and, in a seriously sick patient, may turn the tide between success and failure In 20 years I have sewed a tube into the common bile duct just twice—both within the last year The first was in a woman who had been jaundiced and who had had some pain for two years The jaundice and pain had begun shortly after a cholecystectomy At operation I found a chalky mass filling the common and hepatic ducts, just like a stag-horn stone of the kidney, and in front of it, down near the papilla of Vater, a definitely faceted stone, evidently one which had been formed in the gallbladder The chalky mass in the bile ducts was, of necessity, broken up and removed piecemeal, and I sewed a tube into the common duct, thinking it might provide a means of egress for any particles of the stone that might have been left behind The second case was in a man who had been having gallstone colics for about three months and who had been jaundiced for about six weeks The man was much debilitated and had lost considerable weight At operation I found a small, contracted, thick walled, edematous gallbladder which contained several faceted stones No stones were found in the common duct The head of the pancreas was large and hard It was because of this evident pancreatitis, and the fact that the man had chronic jaundice, that induced me to put a tube into the common duct through the stump of cystic duct, after cholecystectomy Both of these patients recovered very well, but I am not sure but that their recovery would have been hastened had I omitted the common duct drainage

A casual survey of the literature has revealed but one article which advocates the closure of the common duct after the removal of stones Richter and Buchbinder[4] advised the closure of the incision in the common duct and the closure of the abdominal wound without drainage in order to avoid adhesions Two weeks after the appearance of this article there was a letter of comment from the late Dr Wm S Halsted,[5] from which I quote

"I have welcomed the communication of Doctors Richter and Buchbinder upon this important subject (Omission of Drainage in Common Duct Surgery) Although undoubtedly not giving the last word, the authors serve the purpose of stimulating controversy on the vital subject of drainage of the common duct—a subject which surgeons in greater part the world over seem to regard as settled

"The authors emphasize the desirability of closing the abdominal wound without drainage in order to avoid adhesions, taking it for granted, I presume, that it would be superfluous to call attention to the much more serious and

occasionally disastrous results which follow the prolonged loss of bile by way of the incision in the common duct"

Doctor Halsted then went on to explain his method of draining the common duct by a catheter introduced through the cystic duct and finished the letter as follows

"All we gain, as a rule, by drainage of the common duct is relief of tension This relief is secured by drainage by way of the cystic duct and tends to secure prompt healing in the line of suture of the common duct Aside from the deplorable condition of the patient brought about by the great loss of bile, it seems irrational to me to place a drain in the infected common duct through the line of incision into it, with the expectation that primary healing of the wound will take place Unquestionably, the entire line of suture, contaminated inside and out with pus-producing organisms and further imperiled by the pressure of the tube, has in many instances broken down"

The strange thing to me is that this article by Richter and Buchbinder, and the comment on it by such a master surgeon as was Halsted, should have apparently been passed unnoticed by the surgeons of this country for more than 25 years My own practice for 20 years has been, except in very few instances, to close the incision in the common duct after the removal of stones This I effect with the finest of catgut and then place a soft rubber drain close to the line of incision in the duct I have had no cause to regret this procedure In a few instances there has been a slight amount of bile leakage, but I have had no mortality I believe that, if the common duct is closed after the removal of stones, the patients will, in most cases, have an easier, quicker, happier, and safer convalescence

REFERENCES

[1] Howell, W H Text-Book of Physiology Philadelphia, W B Saunders Co, 1933
[2] Judd, E Starr Lewis Surgery, 2, 1955 Hagerstown, Md, W B Pryor Co, 1929
[3] Walters, Waltman Obstructive Jaundice Physiologic and Surgical Aspects (Pamphlet) Journal-Chronicle, Owatonna, Minn, 1934
[4] Richter, H M, and Buchbinder, J R The Omission of Drainage in Common Duct Surgery JAMA, 73, 1750–1751, December 6, 1919
[5] Halsted, W S The Omission of Drainage in Common Duct Surgery JAMA, 73, 1896–1897, December 20, 1919

APPENDICITIS IN ARMY SERVICE

A REPORT OF TWENTY-ONE HUNDRED CASES

RAYMOND W BLISS, M D

LIEUT COL, MEDICAL CORPS U S ARMY

FL PASO, TEXAS

AND

LEONARD D HEATON, M D

CAPTAIN MEDICAL CORPS U S ARMY

FT WARREN, WYOMING

FROM THE SURGICAL SERVICE STATION HOSPITAL FORT SAM HOUSTON TEXAS

FROM January, 1931, to October, 1936, 2,100 operations for appendicitis were performed at the Station Hospital, Fort Sam Houston, Texas, with 10 deaths, a mortality of 0 47 per cent Appendicectomies incidental to other operations are not included This series is presented as being fairly typical of appendicitis and its operative results as obtained in Army hospitals

It is generally agreed that early operation will result in a low mortality rate Our patients are usually admitted early in their illness We receive them from the Army personnel, officers and enlisted men, their families, from the C C C camp enrollees, and, occasionally, from the Veterans' Administration In the first two years covered by this report a good many were admitted by the Veterans' Administration Since then this class of patients has been cared for in Veterans' hospitals All of this personnel receives its medical care from the Army Medical Department In most cases they report any illness early, they are entitled to admission to this hospital, and, in general, they enter the hospital without question when advised to do so by medical officers

Table I shows the age grouping Our youngest patient was an infant, age two months, with an acute suppurative appendix and our oldest a retired soldier, age 71, with an appendiceal abscess Both recovered

TABLE I

AGE GROUPING

Age	Number	Per Cent
0– 5	2	0 09
5–10	34	1 6
10–15	50	2 4
15–20	168	7 9
20–30	1356	64 7
30–40	367	17 5
40–50	100	4 7
50–60	20	0 95
60+	3	0 16

Submitted for publication January 14, 1937

Table II shows the patients' status Of the 437 dependents, 271 were women and 166 children

TABLE II

STATUS OF PATIENTS

Enlisted men	1,085
C C C	349
Veterans' Bureau	149
Officers	80
Dependents of enlisted men	295
Dependents of officers	142
Total	2,100

Tables III and IV give our classification of the types encountered and the number of each type We realize that this classification is open to argument For example The acute catarrhal type, the so-called acute inflammatory type is so classed by the operator, the pathologist may call it suppurative With us the acute catarrhal type represents the simplest type of acute appendicitis without obvious signs of associated peritonitis We believe that patients with this form of the disease would, in the main, recover from that particular attack without operation We further believe that this form of the disease cannot be diagnosed without operation

TABLE III

DEFINITIONS OF PATHOLOGIC CLASSIFICATIONS

(1) Acute catarrhal—Acute inflammatory process limited to the appendix
(2) Acute suppurative—Acute inflammatory process not limited to the appendix Gangrenous type included Local peritonitis in varying degrees present Plastic lymph present Free fluid has seropurulent appearance Not ruptured
(3) Ruptured with peritonitis—Varying degrees of peritonitis No abscess formation
(4) Ruptured with abscess formation
(5) Chronic or interval—Evidence of previous attacks—old adhesions present No acute inflammation

TABLE IV

PATHOLOGIC CLASSIFICATION

	Number in This Series	
	Cases	Per Cent
(1) Acute catarrhal	1,157	55 24
(2) Acute suppurative	567	26 84
(3) Ruptured with peritonitis	54	2 58
(4) Ruptured with abscess	36	1 72
(5) Chronic or interval	286	13 62
Total	2,100	

The acute suppurative and gangrenous types are grouped under the one heading of acute suppurative—the severe fulminating type of the disease This type probably has some mechanical or obstructive element connected

with the pathology plus the infection These appendices will quickly rupture without operation and especially represent the type in which early operation will keep mortality statistics low In the third class no attempt has been made to classify the degree of peritonitis present as localized or spreading

We think that the chronic or interval cases represent, in the main, patients who have had previous attacks of the acute catarrhal type with resultant pericecal and peri-appendiceal adhesions

TABLE V

TYPE OF INCISION

Type	Cases	Per Cent
Transverse	1,129	53 6
McBurney	397	18 9
Right rectus	464	22 14
Midline	110	5 36
Total	2,100	

TABLE VI

ANESTHESIA

	No of Operations	Per Cent
Spinal	1,930	91 8
Gas-oxygen-ether	170	8 2
Total	2,100	

TABLE VII

MORTALITY STATISTICS

Total patients	2,100
Total deaths	10
Mortality per cent	0 47

Classification	Operations	Per Cent Operations	Deaths	Mortality Percentage
Acute catarrhal	1,157	55 0	0	0
Acute suppurative	567	27 0	2	0 35
Ruptured with peritonitis	54	2 5	7	12 9
Ruptured with abscess	36	1 7	0	0
Chronic or interval	286	13 6	1	0 34

Table V shows the type of incision used In women, the midline or right rectus incision is used so that the pelvic organs may be more easily explored In men and children, in whom the diagnosis seems to be uncomplicated appendicitis, we very generally use a transverse incision, placed at about the level of the anterior superior spine, which divides the external oblique fascia, the internal oblique muscle, and the peritoneum transversely This incision is easily enlarged if desirable by cutting the rectus sheath and retracting the rectus muscle toward the midline It avoids the nerves, gives an excellent

and adequate exposure for the purpose intended, is ideal if drainage is required, and in our experience is not followed by muscular weakness or hernia

TABLE VIII

MORTALITY STATISTICS

Age	Number in Series	Number of Deaths
20–30	1,356	6
30–40	367	2
50–60	20	2
Incisions		
McBurney	397	4
Transverse	1,129	3
Right rectus	464	3
Status		
Enlisted men	1,085	6
C C C	349	1
V B	149	3
Anesthesia		
Spinal	1,930	9
Gas-oxygen-ether	170	1

TABLE IX

MORTALITY RATES IN SERIES OF CASES OF ACUTE APPENDICITIS WITH LOCAL PERITONITIS REPORTED IN LITERATURE (SCHULLINGER[1])

Year of Publication	Author	Place	Number of Cases	Period Studied	Mortality Percentage
1925	Adams	London Hospital	467	1919–1923	6 2
1925	Love	St Thomas' Hosp	271	1919–1923	5 2
1927	Colp	Mt Sinai Hosp, N Y	975	1916–1926	3 1
1933	Walker	Boston City Hospital	265	1927–1930	1 5
1933	Seelye	Memorial Hospital, Worcester, Mass	287	1929–1932	1 4
1934	Bower	Philadelphia Hospitals	3,317	1928–1932	2 50
1934	Garlock	New York Hospital II Division	350	1928–July 1932	0 57
1936	Schullinger	Presbyterian Hospital New York	630	1916–1933	1 9
		Total cases	6,562	Average mortality rate	2 8
Cases covered by this report at Station Hospital, Ft Sam Houston, Texas			567	1931–1936	35

Table VI shows that we very generally use spinal anesthesia This seems to us to be decidedly the anesthetic of choice and we believe has a decided

influence on our mortality rates With this anesthetic, handling of the intestines, packs, and retraction are reduced to the minimum We have had no ill effects following its use in this series

TABLE X

TOTAL MORTALITY RATES IN SERIES OF CASES OF ACUTE APPENDICITIS AND ASSOCIATED LESIONS REPORTED IN THE LITERATURE (SCHULLINGER[1] AND MCKENNA[2])

Year of Publication	Author	Place	Number of Cases	Period Studied	Mortality Percentage
1923	Lower and Jones	Cleveland	2,067	Not stated	3 1
1924	Deaver and Magoun	Lankenau Hosp , Philadelphia	5,488	1900–1920	5 0
1925	Adams	London Hosp	1,677	1919–1923	5 8
1925	Love	St Thomas' Hosp	901	1919–1923	8 4
1927	Colp	Mt Sinai Hosp , New York	2,841	1916–1926	5 2
1928	Weeden	New York Hosp	1,588	1914–1927	4 9
1931	Miller	Touro Infirmary and Charity Hosp , New Orleans	2,415	1924–1929	9 9
1931	McDonald	St Mary's and St Luke's Hospitals, Duluth, Minn	1,574	1925–1930	4 5
1932	Boland	Atlanta hospitals	4,270	1927–1932	4 4
1932	Raynor	Manchester Royal Infirmary	1,877	1928–1931	5 0
1932	Colt and Morrison	Aberdeen Royal Infirmary	1,349	1911–1930	5 5
1933	Bauer	General Hosp , Malmo, Sweden	5,208	1903–1930	3 3
1933	Walker	Boston City Hosp	2,106	1927–1930	5 8
1934	Bower	Philadelphia hospitals	14,904	1928–1932	4 79
1934	Nuttall	Liverpool Royal Infirmary	551	Not stated	2 5
1934	Garlock	New York Hosp , II Division	1,188	1921–July 1932	4 7
1934	Keyes	Barnes and St Louis Children's hospitals	1,099	1915–1932	5 0
1934	Quam	Bismarck, N D	1,000	Sept 1927 to Oct 1932	3 8
1936	Schullinger[1]	Presbyterian Hosp , New York	2,653	1916–1933	5 08
1936	McKenna[2]	St Joseph's Hosp , Chicago	3,187	1922–1935	2 48
		Total cases	57,943	Average mortality rate	5 0
Cases covered by this report at Station Hosp , Ft Sam Houston, Texas			2,100	1931–1936	0 47

Table VII is a tabulation of our mortality statistics Autopsies were performed upon the ten patients who died Death in one patient, after an interval appendicectomy, occurred on the fifth postoperative day and came without warning while the patient was reading Autopsy showed a pulmonary embolus The abdomen was clean In the other nine patients death resulted from a spreading peritonitis, two showing a Streptococcic infection of all serous cavities Table VIII is a further analysis of our mortality statistics In Tables IX and X comparative mortality statistics are noted Table IX, acute appendicitis with local peritonitis, corresponds with our acute suppurative classification These figures are taken mainly from Schullinger[1] and McKenna[2]

In acute appendicitis, we believe in operating when we make a diagnosis of appendicitis Our belief in this covers late as well as early cases Together with all surgeons we have operated upon many patients with the fulminating type of the disease and removed gangrenous appendices, almost ready to rupture, a few hours after the onset of symptoms Frequently, the symptoms and physical signs in these patients have been mild and might easily lead the patient and surgeon to procrastinate We cannot determine the type of appendiceal involvement by the symptoms and physical signs and we believe, therefore, that many lives may be saved by operating at the earliest possible moment after the diagnosis of appendicitis is made

In our practice we bury the stump after carbolization or cauterization We employ drainage only in cases of ruptured appendix with abscess formation or with peritonitis Small, soft cigarette or folded rubber tissue drains are used In the cases without abscess formation we believe drainage, in most instances, to be of doubtful value We have not used serum therapy in this series Postoperatively, we avoid dehydration by hypodermoclysis or intravenous injection of salt solution We use the Bartlett tube, or some modification of it, when indicated and believe it to be a life saving measure

SUMMARY—(1) An analysis is presented of 2,100 operations for appendicitis, performed between January, 1931, and October, 1936, with ten deaths, a mortality of 0 47 per cent

(2) The average mortality for 58,000 cases in civil hospitals has been 5 per cent

CONCLUSIONS

In our opinion, the lower rate in this series is due to early admission to the hospital, with prompt operation

We believe that spinal anesthesia contributes to a lower mortality rate

REFERENCES

[1] Schullinger, Rudolph N Arch Surg, 32, 65, January, 1936
[2] McKenna, Hugh ANNALS OF SURGERY, 104, 617, October, 1936

VOLVULUS OF THE CECUM AND ASCENDING COLON

MANDEL WEINSTEIN, M D
LONG ISLAND CITY, N Y

TORSION or volvulus of the cecum and ascending colon is an infrequent and rare cause of intestinal obstruction In 1841 Rokitansky[21] made the first report of a case of this type The earliest, thorough consideration of this condition was published by Von Zoege Manteuffel,[27] in 1898 That this condition is rare may be ascertained from the report of Sweet[25] who reviewed the cases of intestinal obstruction admitted to the Massachusetts General Hospital from the period of 1873–1930, not including those due to strangulated external herniae Of the 520 cases thus studied, only six, or 1 5 per cent, were due to volvulus of the cecocolon To these the author adds another case, making the incidence seven during a period of 57 years However, foreign authors, as Gatellier, Moutier and Porcher,[8] and DuRoux,[6] state that the condition is more frequent where people subsist on coarse vegetable diets, as in Russia, Finland, Poland, and Scandinavia Moreau[16] claimed that volvulus occurred more frequently among Nordic people

The disease is most common in the third and fourth decades of life, and the sex ratio is approximately three males to one female [22] Volvulus of the cecocolon occurs only in the presence of a defect in development, namely, a congenitally long mesentery of the cecum, produced by an abnormal rotation of the cecum from left to right [5] In addition to an abnormally long mesentery, the production of volvulus requires a fixed point about which the intestine can rotate This point may be the mesentery of the small intestine, or a congenital or inflammatory band resulting from a previous operation The first case herewith reported had a chronic adhesive appendicitis with its tip fixed to the posterior parietes by many firm adhesions As a fixed point, this was the contributing cause of the obstruction

Obviously, the occurrence of volvulus in a "cecum mobile" is dependent upon the length of mesentery upon which the cecum hangs In fact, Chalfant[3] estimated that there is marked mobility of the right colon in about 20 per cent of persons of all ages The greater relative frequency of volvulus in males may be due to the fact that males are more exposed to violent muscular effort However, some cases cannot be explained on such a basis, since they occur during sleep Overeating and dietary indiscretion, especially when followed by exercise, also predispose to an attack of volvulus Sudden movements as running, jumping, and lifting a heavy weight may precipitate an attack Habitual constipation, which tends to produce enteroptosis, may be associated with a congenitally enlarged colon, unrelieved even by operation The second case reported in this paper clearly demonstrates this concomitant megacolon

Submitted for publication June 19, 1937

This patient frequently noted "something move a great deal" in his abdomen, especially when he jumped from a short height in the course of his work Drastic purgation may cause an attack of volvulus as pointed out by Cornet and Sargent [4] In the early months of pregnancy, when the enlarging uterus pushes a mobile cecum upward, a partial twist may be produced In addition, the vomiting associated with the pregnant state may be the precipitating factor Volvulus of the cecum complicating labor has been reported by Basden [1] Schroder and Brettschneider [24] studied the literature and collected ten cases of volvulus of the right half of the colon complicating pregnancy A case of postoperative volvulus of the cecum was reported by Nelson [17]

Volvulus of the cecum has been known to be of three types,[9] namely (1) Cecal bascule, in which the posterior surface of the cecum looks forward and the axis of rotation is transverse, (2) rotation in an oblique axis, in which the cecum may occupy the umbilical or even the left hypochondriac region, and (3) rotation of the cecum about its long axis

Embryology—The primitive alimentary canal appears at the end of the fifth week in the form of a tube, and is subdivided into three parts The foregut, the midgut, and the hindgut [19] The blood supply determines these divisions, the foregut being supplied by the celiac axis, the midgut by the superior mesenteric artery, and the hindgut by the inferior mesenteric artery Physiologically, the same subdivisions prevail The foregut is digestive in function, the midgut absorptive, and the hindgut excretory From the foregut, the stomach and duodenum arise down to the bile papilla The midgut gives origin to the remainder of the small intestine, cecum, ascending colon, and the right half of the transverse colon The hindgut forms the balance of the colon and rectum

Among the anomalies of the alimentary tract, there are those due to variations in rotation, descent, and fixation of the intestine [9] In the embryo of from five to five and one-half weeks, the intestine projects forward into the umbilical cord in the form of a wide V-shaped loop supported by a common dorsal mesentery At the apex of the loop is the vitelline duct The limb proximal to it is continuous with the duodenal end of the foregut and that distal with the hindgut At about the sixth week a bud-like enlargement appears in the limb of the loop distal or caudal to the opening of the vitelline duct, which indicates the future position of the cecum and its appendix When the embryo has reached a length of about 40 Mm (tenth week) the coils of intestine rather suddenly return to the abdominal cavity, throwing the cecum over to the right side of the abdominal cavity This position it retains until about the fourth month after birth [26] As the large intestine increases in length, the cecum and appendix move farther to the right, still under the liver, and at about the sixth month descend to their normal position in the right iliac fossa During the process of rotation and descent, the peritoneal surface of the mesocolon, where it comes into contact with the posterior abdominal wall, is normally lost, so that fusion occurs, with fixation of the ascending and descending colon

Developmental anomalies particularly affect the right half of the colon and small intestine Rotation may be incomplete, the cecum and ascending colon remaining to the left, while the transverse colon maintains the normal position Anomalies of rotation are usually coexistent with deficiencies in fixation so that volvulus may result Likewise, lack of peritoneal fusion may be frequent, resulting in abnormal mobility of the ascending colon This mobility may be partial or complete If complete, the whole ascending colon retains its mesentery, and a definite hepatic flexure may be absent Torsion of the cecum and lower ascending colon may result if in partial fixation the cecum itself remains free Thus, one can readily understand how an abnormally long mesentery, a mobile cecum, and a precipitating factor such as muscular effort, may lead to torsion of the cecocolon

Pathology—The torsion usually occurs in a clockwise manner[18 29] the explanation by Von Zoege Manteuffel[27] being the peculiar mesenteric attachment of the ileum Philopwicz[20] found volvulus to occur counter-clockwise in only two out of 24 cases, whereas Weible[29] reported it clockwise in 30 out of 37 cases Von Zoege Manteuffel's conclusions were based upon 20 collected cases and four of his own He observed that torsion up to 180° may occur in the axis of the bowel without interfering with its blood supply, but if the twist goes beyond this point, the mesentery which is necessarily present becomes strangulated Rankin states that a twist of more than one and one-half turns results in strangulation due to occlusion of the vascular elements, gangrene, and occasionally perforation Observations in the two cases reported in this study do not confirm the above findings Both cases presented more than two complete turns, and serious occlusive vascular phenomena failed to result One may conclude that the thoroughness and tightness at the constricting site are deciding factors, rather than the number of turns about a fixed point Unless permanent fixation bands are present to completely occlude the intestine, frequent detorsion may occur due to the great mobility of the cecum

Homan[10] mentions the rapid gas formation in the involved portion of intestine, which does not develop elsewhere to the same degree This observation was made in both my cases, and the enormously distended cecum was out of all proportion to the almost collapsed state of the small intestine proximal to the obstruction In the usual case of intestinal obstruction, even an obstructive lesion low-down causes a marked dilatation of the proximal gut, demonstrating the fact that mechanisms other than those peculiar to intestinal obstruction are involved here In volvulus, the loop is well isolated by the twisted ileum and ileocecal valve proximally, and the transition point of cecum into ascending colon distally In addition, a large amount of fluid intestinal content appears to be absent, another differentiating characteristic from the usual type of intestinal obstruction In other words, this segment is "closed" as far as the intestinal lumen is concerned, but not with respect to the vascular supply Cannon[2] and Keith[13] demonstrated in the cat that the receptively relaxed cecum and ascending colon, upon receiving the liquid contents of the

small intestine, undergo activity in the form of an antiperistalsis which retards and churns their contents for a considerable period This delay favors equally fermentation and the absorption of fluid [7]

However, other causes for the rapid gaseous distention of the involved loop will be presented and described The origin of these intestinal gases is by diffusion from the blood stream into the lumen, the decomposition of intestinal contents, and the passage of atmospheric air from the stomach into the small intestine and colon First, one must consider the mechanism of the diffusion of blood gases to and from the intestinal lumen[15] through the mucosa Absorption into the blood stream is an important method of eliminating intestinal gases The rate of absorption varies with the different gases in the intestine These are Carbon dioxide, hydrogen sulphide, oxygen, hydrogen, methane, and nitrogen The rate of diffusion of carbon dioxide is very rapid as compared to the other gases, and there is always an attempt at equilibrium between the gases in the lumen and those in the blood circulating in the intestinal wall Experiments have been performed ligating the veins of any empty intestinal loop There results a distention of the intestine by a bloody fluid exudate within a few hours, owing to an increase in capillary pressure and damage caused by a poor supply of oxygen If the intestinal loop is distended with air before the veins are obstructed, the volume of gas will increase owing to a diffusion into the lumen of carbon dioxide from the blood

One may, therefore, conclude that in cecocolon volvulus, the constricting mechanism causes a deficient arterial oxygen supply to the involved viscus, together with an accumulation of carbon dioxide in the lumen due to the venous stasis in the intestinal wall The oxygen will be absorbed and replaced by carbon dioxide and other gases, making an ideal culture medium for the anaerobic organisms that normally are found in the colon Anaerobic infections very frequently complicate surgery of the colon, and present one of the most virulent types of infection Ruptured diverticulitis of the sigmoid presents a high mortality because of such contamination In studying the intestinal flora in health and disease, Kahn[12] noticed that uniformly a majority of the control cases exhibited a nonproteolytic anaerobic spore-bearing group of organisms The *Clostridium welchii* was the most frequently encountered species in the stools of normal individuals, although usually in smaller numbers than in some of the pathologic series So virulent are these colonic anaerobes that Weinberg,[30] of the Pasteur Institute, produced two types of serum with anaerobic organisms This serum is being widely used at the present time in the treatment of peritonitis

Patients may give a history of abortive attacks of volvulus, prior to admission for operation Following relief of pain, they evacuate copious, very foul smelling stools This would confirm the fact that the anaerobic content of the involved closed loop may be the cause of the greatly distended cecum

Symptoms and Diagnosis—Volvulus of the cecum presents the clinical

picture of intestinal obstruction, and because of its rarity, is seldom diagnosed except at operation or at autopsy Pain initiates an acute attack, and, because of the severity, is unlike any abdominal pain previously experienced by the patient In both of the cases herewith reported, constipation of two or three days' duration preceded this onset One of the patients had mild attacks for a period of 17 years, while the other was free from such disturbances Evidently, where there is megacolon and great mobility of the cecocolon, the patient experiences so-called chronic attacks The pain of volvulus is intermittent and cramp-like in character, caused by the peristaltic and distending phenomena of hollow viscera, as in any other type of acute intestinal obstruction Like most acute abdominal conditions, a patient's symptoms may be vague and indefinite, simulating the more frequently observed visceral inflammations such as gallbladder disease, as reported by Sarles [23] Great abdominal distention accompanies the attack, and promptly disappears if the obstruction should be relieved spontaneously This is followed by the evacuation of a copious foul stool and gas A large tympanitic mass may be observed in some cases, but the location varies with the amount of mobility of the cecum, as well as its location Vomiting, of course, is a usual accompaniment, and, inasmuch as the obstruction is at a low point in the intestinal tract, signs of toxemia are delayed The elevation of blood urea, decrease in plasma chlorides, and increased combining power of the blood for carbon dioxide obtain with regularity only in high intestinal obstructions [28] Viable bowel has little absorptive power of toxins Enemata and cathartics are of no avail during an attack The patient's only relief is obtained by operation, with mechanical detorsion of the volvulus

Like all congenital abnormalities, volvulus of the cecum may be accompanied by other defects Case 2 also presented an elevation of the right diaphragm If more extensive studies and observations were possible, further abnormalities would probably be discovered Chalfant's[3] case demonstrated a mammalian bicornate uterus in addition to the cecal anomaly

Treatment—For those patients who come to operation, one of three procedures should be considered

(1) Untwisting of the volvulus with the separation of adhesive bands that may be present
(2) A plastic operation to avoid recurrence
(3) Resection of the involved colon

(1) The simplest method, of course, is untwisting the obstructed loop This method may not be applicable in patients with extreme distention of the colon, because slight trauma may rupture and tear the already thinned-out cecal wall One may find omental or inflammatory bands completing the obstruction and these should be severed If, as in Case 2, an adherent appendix helps to precipitate the obstruction, then this must be released and removed As unsatisfactory as simple mechanical untwisting may seem to

the surgeon for permanent relief, yet if the condition of the patient does not warrant further surgery, one must be content with this procedure

(2) Cecostomy and suture of the untwisted cecum to the abdominal wall constitutes the operation of choice The replacement of the greatly distended cecal segment may be facilitated by a radical reduction in its size, following which, fixation bands to the posterior abdominal wall may be more easily visualized, and the exact status of the vascular disturbance ascertained Since the enormous distention may be caused by anaerobic gas formation, as previously mentioned, and not by fluid content in the lumen, perforation by trocar and cannula is a relatively safe procedure Through this opening into the collapsed cecum, a Pezzer catheter No 30 or 32 is inserted, fixed to the margin by catgut, and inverted by a purse-string suture In closing the abdominal wound, several interrupted sutures include the cecal wall above and below the cecostomy opening, thus fixing the cecum to the abdominal wall in the corrected position After the resumption of normal bowel evacuations, the cecostomy gradually ceases to function and the Pezzer catheter may be removed The opening eventually closes without any further surgical procedure

(3) Resection of the cecum with adjacent involved viscera is reserved only for far advanced cases Accompanying this late stage volvulus, one usually finds gangrenous areas of the intestinal wall with necrosis The bowel is so devitalized that contamination of the adjacent peritoneal surfaces is usually present Even slight handling and manipulation may be disastrous The only recourse is rapid resection of the gangrenous portion, delivery of the two open loops of gut outside the abdomen with or without tubes Later, if the patient survives, an attempt may be made to effect continuity and peritonealization However, this radical procedure results in a mortality of 50 per cent, according to Jacobsen [11]

Case 1—No 17254 H J, male, age 62, white, steam engineer, was admitted to the Boulevard Hospital July 23, 1935, at 9 P M, with the chief complaint of pain in the abdomen

History—The patient had never suffered from a serious ailment, even in childhood Never operated upon Cardiorespiratory and urologic systems were essentially negative For many years, there had been present reducible, bilateral inguinal herniae However, for 30 years he had been troubled with symptoms of "stomach ulcer," characterized by the classic picture of hunger-pain, black, tarry stools Roentgenograms, taken several years ago, confirmed the diagnosis of ulcer Loss of 30 pounds in weight during the past year, accompanied by moderate fatigue upon exertion

The pain which caused him to come to the hospital was different from anything previously experienced, and had occurred without any warning signs or symptoms Early on the morning of admission, the patient had suffered pain in the umbilical region, which had gradually increased in severity No flatus had been passed since the onset, and an enema upon admission yielded practically nothing Before entrance, the patient had felt nauseated but did not vomit Soon after being placed in bed, however, he vomited brownish-green material on two occasions

Examination—Reveals an elderly man who appears acutely ill The abdomen presented a large mass to the right of the umbilicus, the size of a grapefruit, tympanitic to

percussion, and somewhat mobile Borborygmus was present No visible peristalsis noted, some tenderness to palpation. Examination of inguinal regions demonstrated complete bilateral inguinal herniae, of large size, which were easily reducible Blood pressure 170/70 Temperature, 100 4° F , pulse, 84, respirations, 22 Uranalysis, essentially negative Leukocytes, 9,400, polymorphonuclears, 72 per cent, lymphocytes, 28 per cent

Operation—Anesthesia gas-oxygen-ether The peritoneal cavity was opened through a right rectus incision over the mass at the level of the umbilicus A loop of greatly dilated intestines with thinned-out wall presented itself, which was identified as a mobile cecum in the upper abdomen It was found to be twisted upon itself several turns because of an abnormally long mesentery The ascending colon was located in the right side of the abdomen, but there seemed to be no point of fixation of the cecum in the right iliac fossa After untwisting the cecum, the small intestine was seen to enter it in the

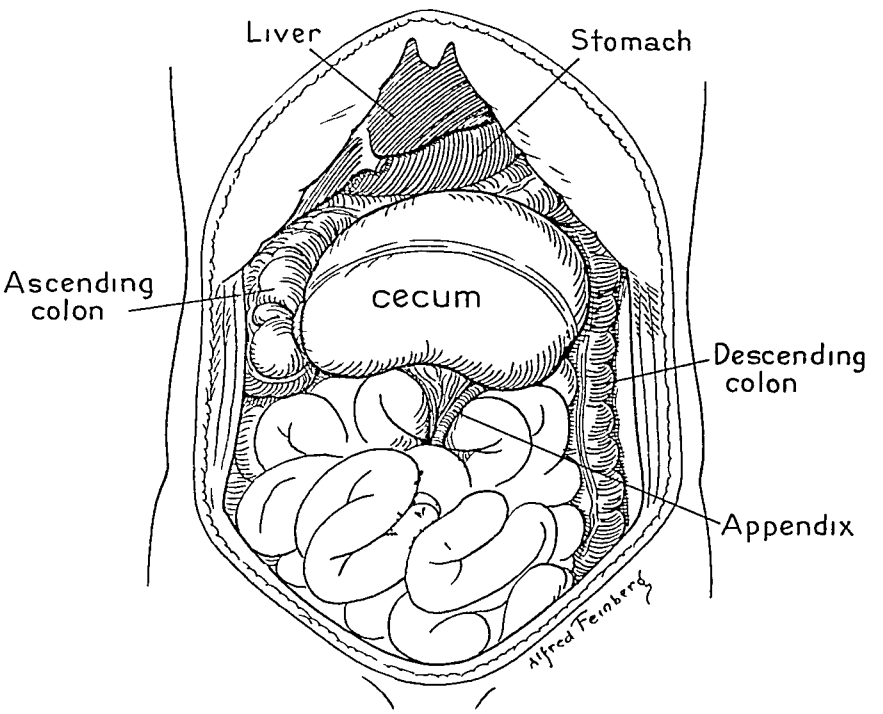


FIG 1—Case 1 Drawing representing the findings at operation A distended mobile cecum was rotated around two fixed points, one being the appendix bound down at its tip by numerous adhesions and the other the ascending colon Note the obstruction of the small intestine by the cord like appendix

usual manner The normal intestinal color immediately returned The appendix, however, was fibrous, tense, cord-like, and fixed to the posterior parietes by broad bands of adhesions which also contributed to the picture of intestinal obstruction by obstructing the ileum (Fig 1) The patient's condition did not warrant prolonged surgery The appendix was removed in the usual manner, after untwisting the volvulus Since the periappendiceal adhesions were factors in the causation of obstruction, we assumed that opportunity for recurrence would be lessened once the adhesions were removed The abdominal incision was sutured in layers

Postoperative Course—A relatively smooth convalescence ensued, aided by intravenous 5 per cent glucose and saline, together with the Wangensteen suction syphonage apparatus However, after the sutures were removed on the ninth postoperative day, patient coughed severely, and produced an evisceration through the wound Secondary suture was immediately undertaken, with through-and-through, interrupted, heavy black

silk, embracing all layers of the abdominal wall He was discharged from the hospital two weeks later in good condition, with a well healed abdominal wound

On September 17, 1935, approximately two months subsequent to discharge from the hospital, he was readmitted for abdominal pain, constipation, vomiting, and abdominal distention The same tympanitic abdominal tumor was present For about two days prior to this recurrent attack of pain, the patient had been constipated, but the present symptoms began only the night before admission Suction syphonage drainage with the Levine tube, and intravenous glucose and saline were instituted All his symptoms disappeared after several copious bowel evacuations had been effected, and he left the hospital at the end of four days

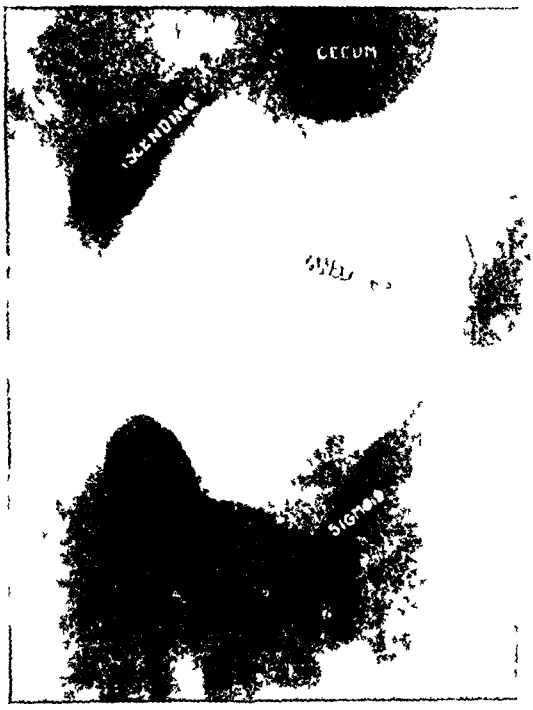


FIG 2—Case 1 A postoperative barium enema study showing the cecum still located in the upper abdomen Cecopexy had not been performed There was no megacolon present

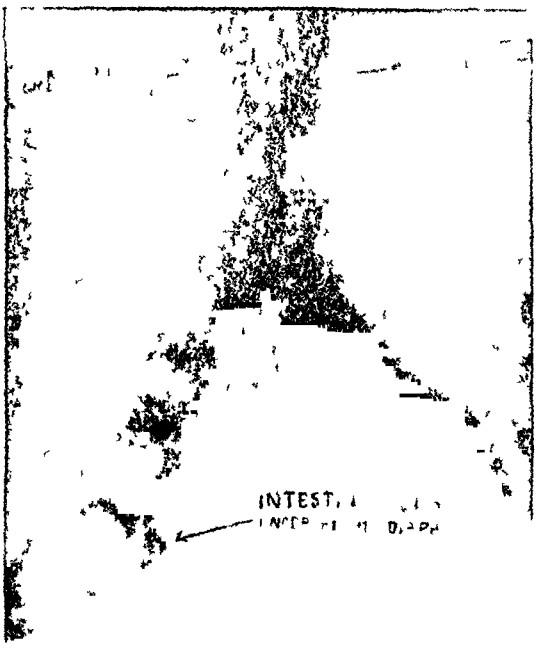


FIG 3—Case 1 Roentgenogram showing a raising of the right leaf of the diaphragm, with coils of intestine between it and the liver

Follow-Up—Sixteen months later the patient seemed well, and stated that he had no pain However, he had been troubled with gas, and often expelled huge quantities subsequent to a stool evacuation Constipation still troubled him His wound was well healed, and the abdomen not distended Roentgenologic studies reveal no great colonic distention The cecum is moderately dilated and still occupies a position in the upper abdomen, in the median line or to the left (Fig 2) Megacolon is not present In addition, his roentgenograms show an elevation of the right diaphragm, and the presence of coils of intestine between it and the right lobe of the liver (Fig 3)

COMMENT—This case demonstrates another factor in the production of cecocolon volvulus in addition to an abnormally long mesentery, namely, inflammatory fixation bands around which the cecum may rotate and obstruct the intestinal lumen In Chalfant's patient an omental band surrounded the intestine at the point of stricture Freeing of a firm adhesion band in McGowan and Dixon's case[14] apparently cured the patient The elevation of the right leaf of the diaphragm was discovered incident to a routine roentgenologic study to determine related anomalies

The occurrence of volvulus was not related to the chronic ulcer illness and happened suddenly, without warning, except for a two to three day interval of constipation If, at the time of operation, circumstances permitted, this patient would be more secure from future attacks if his cecum were sutured to the abdominal wall

Case 2.—No 19817 E H, white, age 40, laborer, was admitted to the Boulevard Hospital June 16, 1936, with the diagnosis of intestinal obstruction Temperature, 99.2° F, pulse 80, respirations 20

History.—During his childhood, patient had measles, scarlet fever, and frequent attacks of tonsillitis Had never had any symptoms referable to his cardiorespiratory system, except frequent "colds" For the past 17 years, has suffered attacks of abdom-

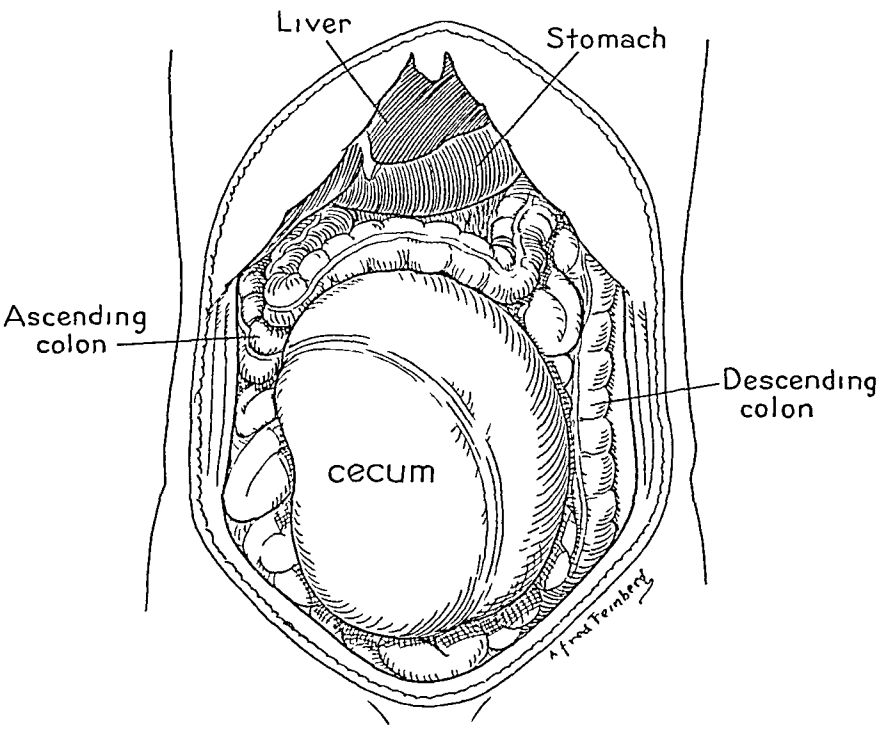


FIG. 4.—Case 2 Drawing representing the findings at operation An enormously distended cecum, the result of volvulus of the cecocolon, occupied a large part of the abdominal cavity

inal pain, occurring approximately every six months These would last from a few hours to as long as one day, coming on at two hour intervals in the beginning, and then increasing in frequency However, for the past few years, these attacks have returned practically every month and would cause discomfort for as long as a whole week No nausea or vomiting ever accompanied these episodes, and he always managed to carry on his usual work He noticed that for two or three days prior to the attacks, he was constipated, and in the interim his stools were dry, hard, and contained mucus with occasional streaks of blood Relief of pain was obtained by doubling up, crossing his knees, and making very firm pressure on his abdomen Cathartics and enemata never gave relief After an attack, he noticed his stools were frothy, contained mucus, were copious in amount, and very foul smelling

Even though he was termed a laborer, he did no heavy work If he were to jump a few feet or bend over suddenly, he would feel something move in his abdomen, whereupon he experienced "sour stomach and belching" These incidents were of

momentary duration He always believed that "his intestines were loose inside of him" Flatus was always evacuated with difficulty, and seemed small in amount

Present attack began one and one-half weeks before admission with spasms of pain, more frequent than ever before The pain was of such severity that, for the first time, the patient had cold sweats For 24 hours prior to operation, his attacks of pain at times recurred every two to four minutes For three days he was completely constipated, not even passing flatus On the day preceding admission to the hospital he had taken castor oil, but with no relief

Physical Examination—Revealed a middle aged male, not in shock Blood pressure 150/90 Head, neck, cardiovascular, and respiratory systems essentially negative Abdomen markedly distended, tympanitic throughout, no masses felt Uranalysis negative, Blood count, 12,000 leukocytes, 62 per cent neutrophils, 2 per cent eosinophils,

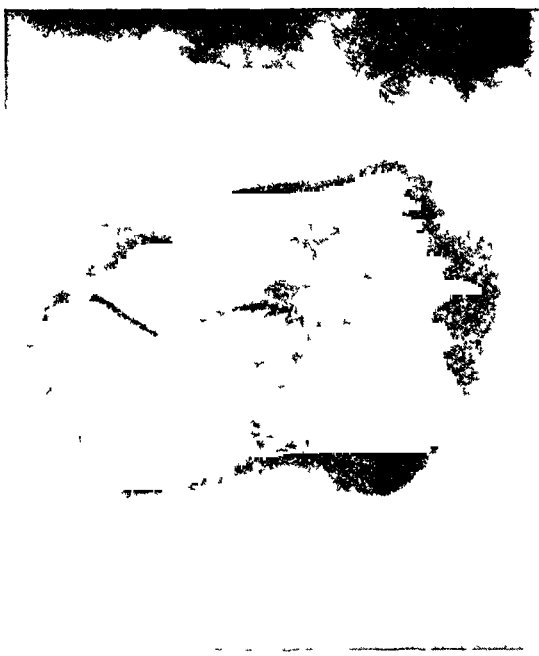


FIG 5—Case 2 Postoperative roentgenogram Barium enema study indicating a large redundant colon, evidently congenital

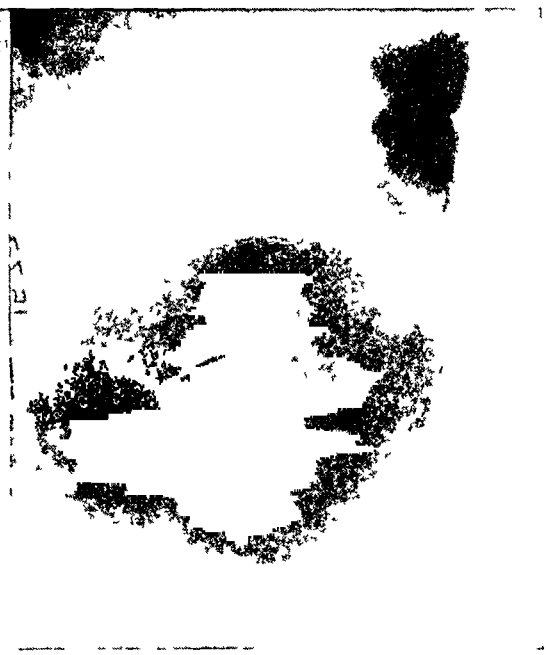


FIG 6—Case 2 Lateral roentgenogram showing cecum fixed to the abdominal wall following cecopexy Still greatly extended

36 per cent lymphocytes For about ten hours, the patient's intestinal tract was decompressed by Wangensteen's method of suction syphonage with a Levine tube, with only slight relief from pain, and no diminution of the abdominal distention

Operation—Under subdural block, using 120 milligrams of neocaine, the peritoneal cavity was entered through a right rectus incision A small amount of tan colored fluid was encountered The cecum and part of the ascending colon were enlarged, distended, and thinned-out, to an unbelievably large size (Fig 4) The obstructive mechanism was a torsion of more than one complete turn produced by a very mobile cecum suspended from the posterior parietes by a long anomalous mesentery The intestinal wall of the involved loop showed no discoloration, or any signs of permanent vascular impairment The colon distal to the affected area was somewhat enlarged and distended, while the small intestine itself was almost collapsed

The involved intestine was untwisted, and a trocar and cannula were introduced, which effected the evacuation of a large quantity of gas, without any accompanying intestinal fluid content Through this small opening a Pezzer catheter No 30 was inserted, and fixed to the edges of the opening into the intestine The cecum itself was fixed to the peritoneal opening by several sutures, and the abdominal wound closed in layers

Postoperative Course—The patient was returned to bed in good condition, and the Wangensteen suction syphonage was immediately reapplied, and two and three thousand cubic centimeters of 5 per cent glucose and saline were administered intravenously during each 24 hours Relief from pain was immediate, and the patient made an uneventful recovery Before discharge from the hospital, on the thirteenth day postoperative, the Pezzer catheter was removed, as the bowels were functioning normally The cecal opening closed completely several weeks later

Follow-Up—Eight months after discharge from the hospital, the patient stated he has enjoyed excellent health, and for the first time as far back as he could recall, he has had one or two daily bowel movements without cathartics His wound was closed and well healed and presented no herniation A moderate amount of distention was still present This was evidently due to the fact that he has a congenitally enlarged and ptosed colon (Figs 5 and 6)

COMMENT—This case illustrates the rapid and extensive gas formation in the closed loop, and the collapsed state of the small intestine The latter was evidently helped by the Wangensteen decompression, but the pathology in the proximal loops did not resemble that occurring in the usual type of intestinal obstruction, with the accompanying infectious inflammatory process of the visceral wall involving the intestine for a great distance proximal to the point of obstruction The lack of complete vascular, occlusive phenomena may be accounted for by the fact that the great mobility of the cecocolon, in spite of the torsion, permitted sufficient blood to pass the point of strangulation The operative procedure of cecopexy and cecostomy selected for this patient is the method of choice The congenital enlargement and mobility of the remaining colon is well illustrated in the roentgenograms, as well as the fixation of the cecum, still distended, to the anterior abdominal wall

CONCLUSIONS

(1) Cecocolon volvulus is a form of intestinal obstruction of infrequent occurrence, depending for its mechanism upon a mobile cecum with an abnormally long mesentery

(2) Abortive attacks of torsion may precede a severe acute attack, and are usually subsequent to periods of constipation

(3) Rapid and extensive gas formation in the involved loop is probably caused by the action of colonic anaerobes growing in an oxygen deficient region

(4) Other congenital anomalies frequently accompany this condition, and should be searched for An elevation of the right diaphragm was discovered in one of the cases herewith reported

(5) The procedure of choice, if operated upon soon enough, is detorsion, cecostomy, and cecopexy

(6) Two cases with cecocolon volvulus are herewith reported, whose course and findings closely resemble those previously recorded in the literature

NOTE—The author wishes to take this opportunity to express his thanks and appreciation to Dr Pol N Coryllos for the many helpful suggestions offered

REFERENCES

[1] Basden, M M Volvulus of Cecum Complicating Labor Brit Med Jour, 1, 1119, 1934
[2] Cannon, W B Functions of the Large Intestine J A M A, 59, 1, July 6, 1912
[3] Chalfant, S S Torsion of the Cecum with Review of the Literature and Report of a Case Am Jour Obst and Gynec, 2, 6, December, 1921
[4] Corner, E M, and Sargent, W P G Volvulus of the Cecum with an Account of Rare and Possibly Common Cases Annals of Surgery, 41, 63, 1905
[5] Counsellor, V S Discussion of Pratt and Fallis' Article in J A M A at Rochester, Minn J A M A, 89, 1225, 1927
[6] DuRoux, P Torsion du gros Intestine Revue Gyn, 19, 325, 1912
[7] Elliott, R R, and Barclay-Smith, E Antiperistalsis and Other Muscular Activities of the Colon Jour Physiol, 31, 272, 1904
[8] Gatellier, J, Moutier, F, and Porcher, P Les volvulus due caecum Arch d mal de l'app digestif, 21, 20, January, 1931
[9] Graham, E A Surgical Diagnosis W B Saunders Co, 2, 629, 1930
[10] Homan, J Torsion of the Cecum and Ascending Colon Arch Surg, 3, 395, 1921
[11] Jacobsen, H Volvulus due caecum Acta chir Scandiav, 56, 181, 1923
[12] Kahn, M C Anaerobic Spore-bearing Bacteria of the Human Intestine in Health and in Certain Diseases Jour Infect Dis, 35, 423, November, 1924
[13] Keith, A A New Theory of the Causation of Enterostasis Lancet, 2, 371, 1915
[14] McGowan, J M, and Dixon, C F Volvulus of the Cecum Report of a Case Proc Staff Meet Mayo Clinic, 11, 337, 1936
[15] McIver, M A, Benedict, E B, and Clive, M W, Jr Postoperative Gaseous Distention of the Intestine Arch Surg, 13, 588, October, 1926
[16] Moreau, C Un cas d'occlusion intestinale par torsion due caecum et de l'origine due colon ascendant Bull et mem Soc de chir de Paris, 22, 583, 1930
[17] Nelson, J M Postoperative Volvulus of Cecum Am Jour Surg, 5, 398, 1928
[18] Ohman, E Volvulus of Cecum Finska Lak-Sallsk Handl, 66, 597, July, 1924
[19] Pratt, J P, and Fallis, L S Volvulus of Cecum and Ascending Colon J A M A, 89, 1225, 1927
[20] Philopwicz, W Weitere Beitrage zur Casuistick und Aetiologie des Dumdarm-Volvulus Arch f klin Chir, 97, 844, April, 1912
[21] Rokitansky, C Intestinal Strangulation Arch Gen Med, 14, 202, 1837
[22] Rankin, F W Surgery of the Colon D Appleton & Co, N Y, 1, 80, 1926
[23] Sarles, M Volvulus due caecum a symptomatologie pseudo-vesiculare avec diarrhee Arch de mal l'app digestif, 19, 731, 1929
[24] Schroder and Brettschneider Quoted by Ohman
[25] Sweet, R H Volvulus of Cecum Acute and Chronic with Report of 8 Cases New Eng Jour Med, 213, 287, 1935
[26] Treves, F Lectures on Anatomy of the Intestinal Canal and Peritoneum in Man Brit Med Jour, 1, 1888
[27] Von Zoege Manteuffel Die Achsenderhungen Des Caecum Verhandl d deutsch Gesellsch f Chir, 27, 526, 1930
[28] Wangensteen, O H Therapeutic Consideration in the Management of Acute Intestinal Obstruction Arch Surg, 26, 933, 1933
[29] Weible, R E Volvulus Torsion of the Whole Mesentery Surg, Gynec, and Obstet, 19, 644, November, 1914
[30] Weinberg Quoted by Dixon, D F, and Bargen, J A -Vaccination Preceding Colonic Operations as Protection against Peritonitis N Y S Med Jour, 35, 10, May 15, 1935

ARGENTAFFINE TUMORS OF THE GASTRO-INTESTINAL TRACT

REPORT OF THREE CASES ONE WITH DISTANT METASTASES

THOMAS E WYATT, M D

NASHVILLE, TENN

FROM THE DEPARTMENT OF SURGERY, VANDERBILT UNIVERSITY NASHVILLE, TENN

THERE have been numerous reports of "carcinoids" or argentaffine tumors of the gastro-intestinal tract Excellent summaries of this literature have been made by Forbus,[10] Cooke[3] and Raiford [33] By elaborating on the work of Masson,[25] Lubarsch[21] and Oberndorfer[29] they have definitely classified this neoplasm

Although it was recognized that this tumor produced distant metastases, as was reported, in 1890, by Ransom,[34] it was still considered benign by some authors, as late as 1934 It is still questioned whether or not the tumor is of epithelial origin and consequently properly classified as a carcinoma

Thus they present a definite clinical problem although the peculiarities of the tumors may have excited an interest which is beyond their significance No doubt this tumor has escaped recognition on numerous occasions when appendicectomy has been performed In relatively few instances is it recognized grossly and the diagnosis is made only after histologic examination

In the small intestine, it has been encountered most frequently at operation and in the large bowel at autopsy It has manifested itself clinically by causing intestinal obstruction and intussusception Occasionally it has made itself known by its metastases, and on several occasions has been discovered in a Meckel's diverticulum In the appendix it is usually encountered in association with acute or chronic appendicitis In no case, in the literature, has it been diagnosed preoperatively in any part of the gastro-intestinal tract

The historic aspects of the argentaffine tumors have been so well presented by Forbus, in 1925, that only a brief resume is necessary Lubarsch, in 1888, reported two cases of multiple growths in the ileum and designated them as primary carcinoma although they appeared somewhat atypical Ransom then, in 1890, described a tumor resembling that of Lubarsch except that although the primary site was in the ileum, it extended through the wall of the intestine and a short distance into the mesentery There were also nodules in the liver identical in cellular appearance to those in the ileum

In quick succession there followed several reports of this type of tumor in which there were metastases to regional lymph nodes and to the liver Several other cases of primary tumor were reported and many of these were spoken of as "endothelial sarcoma" Lubarsch by the use of a silver impregnation method of staining was able to show a definite relationship between the cell nests of the tumor and the crypts of Leiberkuhn, which suggested an epi-

Submitted for publication August 16, 1937

thelial origin To Lubarsch goes the credit of definitely distinguishing this tumor from the cylindrical cell adenocarcinoma occurring in the gastro-intestinal tract

Because of certain morphologic resemblances Bunting considered these tumors analogous to the basal cell carcinomata of the skin, which had been described by Krompecher [19] Oberndorfer, in 1907, first termed these tumors "carcinoid" His observations were made on six cases of multiple tumors of the small intestine, and he differentiated them from carcinoma on the basis that they were generally multiple, that they had no tendency to infiltrate surrounding tissue, that the cells were found in undifferentiated masses, that growth was slow and that they did not metastasize He then held that they were embryonal malformations

Huebschmann[16] first made the suggestion, in 1910, that these tumors might possibly arise from chromaffine cells Oberndorfer then found that their cells stained with chromium salts Gosset and Masson,[13] in 1914, by studies of the chromaffine cells of the gastro-intestinal tract, discovered the cytoplasmic granules which reduce an ammoniacal solution of silver

McGlannon and McCleary,[22] Dukes and Lockhart-Mummery[8] had previously found that carcinoid tumors were rich in cells with cytoplasmic granules which gave the characteristic argentaffine reaction Forbus, Hasegawa[14] and Danisch[6] substantiated the finding of silver reducing cytoplasmic granules in cells in the crypts of Lieberkuhn Forbus by this method of staining was able to point out a third type of tumor which morphologically resembled the carcinoid tumor but followed the clinical course of cylindrical cell adenocarcinoma The cells of this tumor did not contain granules which reduced silver

Previously Trappe[44] had stated that carcinoid tumors arose from pancreatic rests in the intestinal tract and Saltykow,[36] in 1912, agreed with Toenniessen that the carcinoids were derived from rests composed entirely of cells like those of the islets of Langerhans

At the present time it is generally conceded that "carcinoid" or "argentaffine" tumors arise from the Kultschitsky cells found in the base of the crypts of Leiberkuhn This theory is adhered to by many later authors, among them Gáspár,[12] who showed excellent evidence by means of serial sections that this tumor arises from the cells in the crypts of Leiberkuhn and that the cells of both the primary tumor and its metastases contain silver reducing granules in their basal portions as do the Kultschitsky cells of the intestinal epithelium On this basis he concluded that this tumor should be classified as carcinoma Cooke, Raiford and Humphreys[17] also used these histologic methods and were able to demonstrate silver reducing granules in cells of both the primary tumor and its metastases

CASE REPORTS

Case 1.—A female, age 18, white, was admitted to the Surgical Service of the Vanderbilt University Hospital complaining of pain and tenderness in the right lower quadrant of the abdomen of 20 hours' duration, nausea and vomiting appeared after

the onset of pain She had had no previous similar illness There were no genito-urinary symptoms and no diarrhea

Physical Examination—The patient was a pale, rather poorly nourished girl who appeared to be very ill Temperature, 100 2° F , white blood cells, 9,300 Uranalysis was negative The salient physical findings were confined to the abdomen On palpation there was tenderness over the entire right side, more marked in the right lower quadrant There was mild muscular rigidity over the area of tenderness

A diagnosis of acute appendicitis was made and the appendix was removed through a right rectus incision The mesenteric lymph nodes were not remarkable at time of operation

Pathologic Examination—Gross The appendix was 7 cm in length The proximal two-thirds were rather pale but the tip was bulbous and red, the blood vessels were engorged On opening the appendix the lumen was found to be patent and filled with mucopurulent material The mucosa was somewhat hemorrhagic There was no evidence of perforation

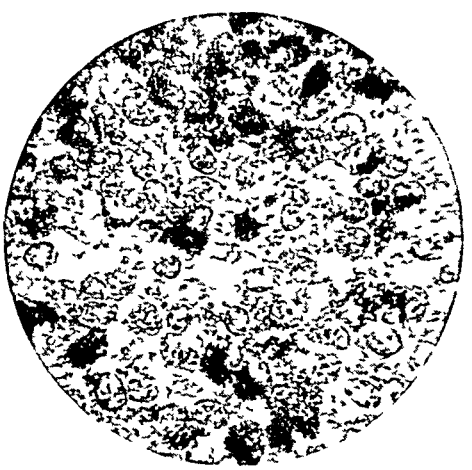


FIG 1—Case 1 Photomicrograph of a tumor cell nest showing the silver reducing granules of the tumor cells (oil immersion)



FIG 2—Case 2 Photomicrograph showing typical arrangement of cell groups with invasion of the musculature (high power)

Microscopic—The tip of the appendix showed the normal architecture to have been obliterated by cell nests and strands, the picture being typical of the argentaffine tumor In addition the walls of the organ were infiltrated with polymorphonuclear leukocytes Sections through the proximal two-thirds showed it to be essentially normal The tumor cells were found to reduce silver (Fig 1)

Follow-Up—The patient reported herself well nine years after operation

Case 2—A female, age 18, white, was seen 21 hours after onset of generalized abdominal pain The pain became localized in the right lower quadrant ten hours after onset At this time she became nauseated and vomited several times There were no urinary symptoms, no diarrhea or dysmenorrhea One year previously she had a similar attack which lasted for two days and which was not so severe The remainder of the past history was not remarkable

Physical Examination—The patient was a well developed and well nourished young white girl who appeared to be quite ill and in much pain Temperature, 100 8° F , white blood cells, 32,000 Uranalysis was negative The only physical findings of importance were confined to the abdomen, which was noted to move very poorly on respiration There was almost board-like rigidity of the abdominal muscles and marked tenderness over the entire right lower quadrant

The diagnosis of acute appendicitis was made and the appendix was removed through a right rectus incision The mesenteric lymph nodes were palpable but were very small and soft

Pathologic Examination—Gross The appendix was 5 5 cm in length It was markedly swollen, reddened and covered with a shaggy fibrinous exudate The lumen, although patent, was filled with purulent material The walls were much thicker than normal, particularly in the distal third, and on section they gave a "gristly" feel as the knife passed through them

Microscopic—Sections through the distal third showed the typical appearance of the argentaffine (Fig 2) tumor, while sections through the proximal two-thirds showed no evidence of the tumor In addition, the walls were densely infiltrated with polymorphonuclear leukocytes The tumor cells reduced silver

Follow-Up—On two occasions this patient has returned to the hospital with symptoms of partial intestinal obstruction which disappeared with conservative treatment She was well five months after operation

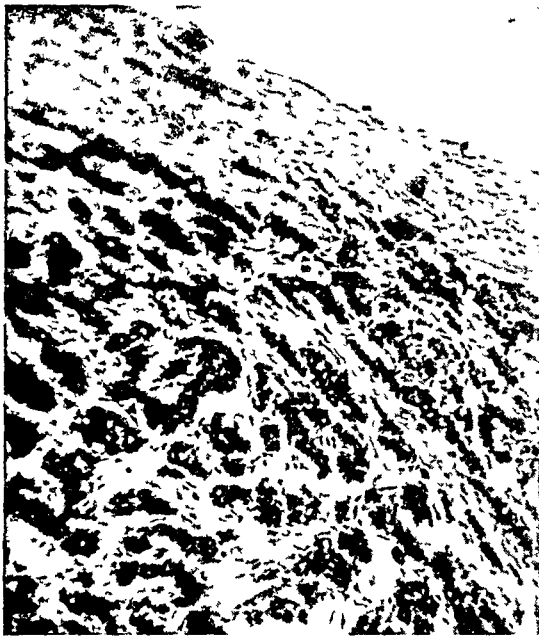


FIG 3—Case 3 Photomicrograph of subserous tumor of the cecum, showing invasion of the musculature (high power)



FIG 4—Case 2 Photomicrograph of a metastasis to the liver (high power)

Case 3—A male, age 55, colored, had had numerous admissions to the hospital He had been found to have syphilitic aortitis with aneurysm of the aortic arch, tabes dorsalis and perforating ulcers of the feet Death was presumably due to syphilis There was no history referable to the gastro-intestinal tract which would lead one to suspect the presence of a tumor of the cecum At autopsy in addition to the aortitis and pulmonary congestion there were two tumors found in the cecum One was an ulcerated firm polypoid mass measuring 5 6×6 cm The second was a movable subserous mass approximately the same size as the first tumor (Fig 3) On section they were both yellowish-white in color There were several small shrunken areas noted in the liver which had the same yellowish-white color as the tumors of the cecum

Microscopic—Both tumors were found to be identical in structure, and were typical of the argentaffine tumor Sections of the metastases in the liver showed the same type of tumor as was found in the cecum (Fig 4) Cells of both tumors of the cecum were found to reduce an ammoniacal solution of silver as did the cells of the metastases in the liver

Pathology—Humphreys found, from a study of the literature, of all reported cases of argentaffine tumors of the gastro-intestinal tract, with exception of the appendix, that 30 per cent were multiple as opposed to the usual single cylindrical cell carcinoma Discovery of one of these tumors at operation should lead to a search for others

They are most likely to occur as nodules in the submucosa and if pedunculated, ulceration may be present They are usually small in size but may attain the size of any other malignant neoplasm of the bowel They have on occasion been mistaken for ordinary adenocarcinoma since there is so little difference in gross appearance They have occasionally been encountered as "napkin-ring" tumors constricting the lumen of the intestine In consistency, they are usually rubbery rather than being hard The color on cut section is usually a yellowish-white but some have been described as white or gray

Microscopically these tumors are composed of round or polygonal cells The nuclei are vesicular and contain a large amount of chromatin The cytoplasm is pale and its outline is indefinite

The cells are usually clumped in nests or strands with an outer rim of cells whose nuclei are peculiarly hyperchromatic and, seen in section, they are drawn away from the dense stroma They may form in groups about what appears to be a lumen Some of the cell strands extend into the muscle layers

The stroma of the argentaffine tumor is usually very dense and places the cell groups in "splendid isolation" Mitotic figures are scarce

Arising supposedly as it does from the Kultschitsky cell of the intestinal epithelium, most of the cells contain granules which reduce silver Not all the cells contain granules, and these are termed "indifferent" Sections of a normal appendix and cylindrical cell adenocarcinoma will, if stained with silver, usually show an occasional cell containing granules Sections of primary argentaffine tumors and their metastases, stained with silver, contain large numbers of cells with the characteristic granules

These tumors in the appendix are usually located at the tip, sometimes forming a bulb-like mass They rarely extend beyond the proximal two-thirds of the organ The histologic picture in the appendix is exactly as in other parts of the intestine except that in most cases there is an inflammatory process present

In the appendix the tumor is not always apparent on gross examination and the diagnosis is often made only after study of several sections Norment[28] states that, in his series, only 34 per cent of the appendices containing the tumors were enlarged at the site of the neoplasm However, cases have been reported in which the bulbous tip of the organ has become so large that it could be palpated through the abdominal wall

COMMENT—*Incidence and Malignancy* The literature contains a large number of reports of isolated cases of carcinoid of the appendix and an occasional report of a series of cases Many authors fail to make any dis-

tinction between cylindrical cell adenocarcinoma and the spheroidal cell argentaffinoma Others make careful distinction but do not consider the silver-reducing tumor malignant

The largest series reported is by Noiment, who found 67 carcinomata in 45,000 appendices removed at operation Two of these he designates as the columnar cell type and the remaining 65 as the spheroidal cell argentaffinoma

Smith,[39] in his series, found 21 carcinoids in 7,865 appendices removed at operation

According to St George,[42] there was no case of carcinoid encountered in Bellevue Hospital prior to 1916, and since that time carcinoids of the appendix were found only twice in 18,700 autopsies Also at Bellevue Hospital in a series of 9,108 appendicectomies the tumor was found only seven times

In the Vanderbilt University Hospital, the two cases cited herewith were the only argentaffine tumors found in 2,179 appendicectomies The single case of multiple tumors of the large bowel is the only case in 1,744 autopsies

These tumors are reported to arise from all parts of the gastro-intestinal tract except the esophagus, duodenum, and rectum They are of course encountered more frequently in the appendix than elsewhere Of all the carcinoids of the appendix which have been reported, only five have extended beyond the organ itself The extent of metastases varied from extension to the mesentery only, to widespread metastases in the mesentery, omentum, and in one case in the pleura

Humphreys, in 1933, brought the total number of argentaffine tumors of the small intestine to 152 Since that time there have been seven more reported One each by Christopher[2] and Jones,[18] both of which were located in the ileum and had not metastasized One by Price[32] was found in a Meckel's diverticulum and had not metastasized Two by Lee and Taylor,[20] both of which were in the ileum and both of which had metastasized to the regional lymph nodes One by Warren and Gates[46] and one by Wood[48], both of these tumors were encountered in the ileum and had metastasized to the regional nodes

With these seven additional cases the total now reported is 159 and of this number 36 have metastasized (Table I), representing 22 5 per cent of the series of tumors of the small intestine This figure may be compared with that obtained by Craig[5] who studied a series of adenocarcinomata of the small intestine and found that 36 per cent had metastasized at time of operation

With the present case there are now nine reported tumors of the large bowel, three of which had metastasized In the instances reported by Raiford, one had metastasized to the regional nodes and the other to regional nodes, liver and lungs Although the series is small, it is of interest to compare it with the figures of Hayes,[15] who found in a study of a large series of adenocarcinomata of the large bowel that 37 per cent had metastasized at time of operation

Prognosis and Treatment—From the foregoing statistics it is evident that carcinoid or argentaffine tumor is not a harmless lesion It is true that many

TABLE I

SYNOPSIS OF MALIGNANT CARCINOIDS COLLECTED FROM THE LITERATURE

Author	Year	Primary Site of Tumor	Site of Metastases	Age	Race	Sex
Ransom	1890	Small bowel	Liver			
Versé	1908	Small bowel	Regional lymph nodes			
Enstratoff	1911	Small bowel	Liver			
Saltykow	1912	Small bowel	Regional lymph nodes			
Dietrich	1913	Ileum	Liver	62	W	F
Schopper	1913	Ileum	Liver and regional nodes	54	W	M
Engel	1920	Small bowel	Regional lymph nodes			
Bakke	1921	Small bowel	Regional lymph nodes			
Schnebel	1923	Ileum	Liver	50	W	M
Dukes and Lockhart-Mummery	1926	Ileum	Peritoneum, liver, regional nodes	76	W	F
Stewart and Taylor	1926	Appendix	Pelvis	31	W	F
Decker	1928	Small bowel	Regional lymph nodes			
Brocher	1928	Small bowel	Liver	28	W	F
Oberndorfer	1929	Appendix	Regional lymph nodes	28	W	F
Oberndorfer	1929	Ileum	Regional lymph nodes	52	W	F
Oberndorfer	1929	Ileum	Regional lymph nodes Mesentery	81	W	F
Oberndorfer	1929	Ileum	Regional lymph nodes Mesentery	41	W	F
Oberndorfer	1929	Ileum	Regional lymph nodes	48	W	F
Pack and Davis	1930	Ileum	Regional lymph nodes	73	W	M
Gáspár	1930	Jejunum	Regional nodes and liver	74	W	F
Philips and Isaac	1930	Appendix	Ext to omentum			
Knoflach	1930	Appendix	Ext to mesentery	64	W	M
Ritchie	1930	Ileum	Mesentery and liver			
Marangos	1931	Ileum	Regional nodes and liver	68	W	F
Cooke	1931	Ileum	Regional lymph nodes and liver	67	W	M
Cooke	1931	Ileum	Regional lymph nodes and liver	65	W	F
Cooke	1931	Ileum and jejunum	Regional lymph nodes and liver	60	W	M
Scholte	1932	Ileum	Mesentery and regional lymph nodes	40	W	M
Mörl	1932	Appendix	Mesentery, pleura, omentum	49	W	M
Mörl	1932	Ileum	Regional lymph nodes	26	W	M
Morl	1932	Ileum	Regional lymph nodes	59	W	M
Meeker	1932	Small intestine	Regional lymph nodes	61		
Raiford	1933	Stomach	Regional lymph nodes and liver	55	W	M
Raiford	1933	Ileum	Regional lymph nodes and peritoneum	45	W	F
Raiford	1933	Ileum	Regional lymph nodes and liver	57	W	M
Raiford	1933	Appendix	Ext to cecum and ileum	16	W	F

Author	Year	Primary Site of Tumor	Site of Metastases	Age	Race	Sex
Raiford	1933	Sigmoid	Regional lymph nodes, liver, lungs	53	C	M
Raiford	1933	Cecum	Regional lymph nodes	46	W	F
Humphreys	1934	Ileum	Regional lymph nodes	60	W	M
Humphreys	1934	Ileum	Regional lymph nodes	60	W	M
Humphreys	1934	Ileum	Regional lymph nodes	47	C	M
Lee and Taylor	1934	Ileum	Regional lymph nodes	51	W	F
Lee and Taylor	1934	Ileum	Regional lymph nodes	53	W	F
Warren and Gates	1934	Ileum	Regional lymph nodes	53	W	F
Ward	1936	Ileum	Regional lymph nodes	62	W	F

of the tumors were unsuspected and were found at autopsy yet many caused definite symptoms It is a fact that none of these tumors have been diagnosed preoperatively, but it is of extreme importance that they be recognized when once encountered as they offer a much better prognosis than does adenocarcinoma The tumor appears to grow slowly and to metastasize late If metastases are not present at time of operation prognosis is good, and favorable results have been obtained with removal of the tumor and the regional nodes containing metastases Few tumors of the appendix have metastasized in spite of their frequency It is possible, however, that the presence of these tumors in the appendix leads to an inflammatory process which brings about their earlier recognition

All "carcinoids" must be considered slow growing malignant tumors

As in other malignancies of the gastro-intestinal tract, surgical intervention is the only means of treatment The effect of roentgenotherapy on the growth of these tumors has not yet been determined

SUMMARY

(1) A brief resume of the theories concerning the argentaffine tumors has been presented

(2) Two cases of argentaffine tumor of the appendix have been presented, as well as one case of a multicentric argentaffine tumor of the cecum with metastases to the liver

(3) This tumor is a carcinoma arising from the Kultschitsky cell of the intestinal epithelium

(4) The pathology of these tumors has been briefly reviewed

(5) The reported cases in the literature have been collected, and 22 5 per cent of tumors of the small intestine were found to have metastasized Of the nine cases of the large bowel, three had metastasized

(6) All "carcinoids" are slow growing but malignant tumors A good prognosis is presented after surgical intervention, even when metastases to the regional nodes have occurred

I wish to thank Dr Ernest W Goodpasture for his assistance and the use of the records of the Department of Pathology

REFERENCES

[1] Carr, J T Argentaffine Tumors of the Small Bowel with Report of Two Which Caused Intestinal Obstruction Am Jour Surg, 13, 56, 1931

[2] Christopher, Frederick Iliac Carcinoid Surg, Gynec, and Obstet, 58, 903–905, 1934

[3] Cooke, H H Carcinoid Tumors of the Small Intestine Arch Surg, 22, 568, 1931

[4] Cowdry, E V Special Cytology, vol I New York, N Y, Paul B Hoeber

[5] Craig, W McK Lymph Glands in Carcinoma of the Small Intestine Surg, Gynec, and Obstet, 38, 479, 1924

[6] Danisch, F Zur Histogenese der Sogenonnten Appendix karzinoide Beitr z Path Anat u z allg Path, 72, 687, 1924

[7] Darnall, W E, and Kilduff, R A Carcinoma of the Appendix Am Jour Surg, 17, 32, 1932

[8] Dukes and Lockhart-Mummery Carcinoid Tumor of the Ilium with Metastases Journal Path and Bact, 29, 398, 1926

[9] Ewing, James Neoplastic Diseases Third Edition, W B Saunders Co, Phila

[10] Forbus, W D Argentaffine Tumors of the Appendix and Small Intestine Bull Johns Hopkins Hosp, 37, 130, 1925

[11] Goevaerts, J Les Tumeurs Carcinoides de l'intestine grele Scalpel, 85, 949–960, 1932, (Abs Am Jour Cancer) 19, 178, 1933

[12] Gaspar, Istvan Metastasizing "Carcinoid" Tumor of Jejunum Am Jour Path, 6, 515, 1930

[13] Gosset, A, and Masson, P Tumeurs endocrines de l'appendice Presse Med Par, 22, 237, 1914

[14] Hasegawa, T Uber die Carcinoide der Wurmfontsatzes und des Dunndarmes Virchows Arch f path Anat, 244, 8, 1923

[15] Hayes, J M Involvement of the Lymph Glands in Carcinoma of the Large Intestine Minnesota Med, 4, 653–663, 1921

[16] Huebschmann, P Sur le carcinome primitif de l'appendice vermiculaire Rev Med de la Suisse Rom Geneve, 30, 317, 1910

[17] Humphreys, E M Carcinoid Tumors of the Small Intestine Report of Three Cases with Metastases Am Jour Cancer, 22, 765, 1934

[18] Jones, C B Argentaffine Cell Tumors "Carcinoids" of Small Intestine and Appendix Am Jour Surg, 34, 294, 1936

[19] Krompecher, G Uber die Basalzellentumoren der Zylinderepithelscheimhaute mit besonder Berucksichtigung der "Karzinoide" des Danns Beitr z path Anat u z allg Path, 65, 79, 1919

[20] Lee, W, and Taylor, J S Argentaffine Tumors of the Terminal Ileum Surg Gynec, and Obstet, 59, 469, 1934

[21] Lubarsch, O Ueber den primaren Krebs des Leum nebst Bemerkungen uber das gleichzeitige Varkommen von Krebs und Tuberculose Virchows Arch f path Anat, 111, 280–317, 1888

[22] McGlannon, A, and McCleary, S Carcinoid Tumors of the Small Intestine J A M A, 89, 850, 1927

[23] Marangos, G N Zur Kenntnisder Dunndarmcarcinoide Beitr z Path Anat u z allg Path, 86, 48, 1931, (Abs Am Jour Cancer), 15, 1762, 1931

[24] Masson, P Carcinoids (Argentoffine-cell Tumors) and Nerve Hyperplasia of the Appendicular Mucosa Am Jour Path, 4, 181, 1928

[25] Masson, P The Significance of the Muscular "Stroma" of Argentaffin Tumors (Carcinoids) Am Jour Path, 6, 499, 1930

[26] Meeker, L H A Case of Malignant Carcinoid of the Ileum Arch Path, 14, 264, 1932

[27] Morl, F Uber die Karzinoide des Wunnfortsatzes und des Dunndarmes Beitr z klin chir, 153, 71, 1931, (Abs Am Jour Cancer), 16, 389, 1931

[28] Norment, William Tumors of the Appendix Surg, Gynec, and Obstet, 55, 590, 1932
[29] Oberndorfer, S Karzinoide Tumoren des Dunndarmes Frankfurt Ztschr f Path, 1, 426–432, 1907
[30] Pack, G T, and Davis, A H Carcinoid Tumors of the Small Intestines Am Jour Surg, 9, 472, 1930
[31] Phillips, E W M, and Isaac, D H Primary Carcinoma of the Appendix Brit Med Jour, 1, 1127, 1930
[32] Price, I Carcinoid Tumour of a Meckel's Diverticulum Report of a Case Brit Jour Surg, 23, 30, 1935–1936
[33] Raiford, T S Carcinoid Tumors of the Gastro-intestinal Tract (So-called Argentaffine Tumors) Amer Jour Cancer, 18, 803, 1933
[34] Ransom, W B Primary Carcinoma of the Ilium Lancet, 2, 1020, 1890
[35] Ritchie, G Argentaffine Tumors of the Small Intestine Arch Path, 10, 853, 1930
[36] Saltykow, S Uber die Genese der Karzinoiden Tumoren, sowie der Adenomyome des Darmes Beitr z path Anat u z allg Path, 54, 559, 1912
[37] Scholte, A J Ein Fall von Angioma Telangiectaticum cutis mit chronischec Endocarditis und Malignen Dunndarmcarcinoid Beitr z path Anat u z Allg Path, 86, 440, 1931, (Abs Am Jour Cancer), 16, 132, 1931
[38] Semsroth, K The Histiogenetic Interpretation of Certain Carcinoids of the Small Intestines Arch Path, 6, 575–584, 1928
[39] Smith, G Primary Epithelial Tumors of the Vermiform Appendix Arch Path, 15, 78, 1933
[40] Stewart, M J, and Taylor, A L Carcinoid Tumor of Appendix with Large Pelvic Deposits Jour Path and Bact, 29, 136, 1926
[41] Stewart, M J and Taylor, A L Carcinoid Tumor of Meckel's Diverticulum Jour Path and Bact, 29, 135, 1926
[42] St George, A V Carcinoids of the Appendix Am Jour Clin Path, 4, 297, 1934
[43] Toenniessen, E Untersuchungen Uber die in der submukose des Dunndarmes vorkommenden epithelen Tumoren Ztschr f Krebsforfch Beal, 8, 355, 1910
[44] Trappe, M Ueber geschevulstortige Fehlbildungen von Niere, Milz haut und Darn Frankfurt Ztschr f path, 1, 109, 1907
[45] Vance, C A Primary Carcinoma of the Vermiform Appendix Am Jour Surg, 24, 854, 1934
[46] Warren, Shields and Gates, Olive Multiple Malignancy with Metastasizing Carcinoid of Ileum and Miliary Tuberculosis Arch Path, 18, 524, 1934
[47] Wilmoth, C L Carcinoid Tumors of the Appendix ANNALS OF SURGERY, 90, 261, 1929
[48] Wood, W G A Carcinoid Tumour of Lower Ileum Brit Jour Surg, 23, 764, 1935–1936

THE MECHANISM OF SPASTIC VASCULAR DISEASE AND ITS TREATMENT *

PETER HEINBECKER, M D , AND GEORGE H BISHOP, PH D
ST LOUIS, MO

FROM THE DEPARTMENT OF SURGERY AND THE LABORATORY OF NEUROPHYSIOLOGY OSCAR JOHNSON INSTITUTE WASHINGTON UNIVERSITY SCHOOL OF MEDICINE ST LOUIS MO

BY SPASTIC vascular disease is meant the pathologic state of blood vessels whereby they undergo abnormal contraction on exposure to cold or on emotional excitement In mild cases there is no pathology demonstrable histologically in the vessels or tissues In the more severe cases, presumably as a result of the disease process or of associated metabolic disturbances, there occurs swelling of the intima in small arteries and arterioles which may progress to actual occlusion (Fig 1) Trophic disturbances in the tissues other than the blood vessels then result These consist of atrophy of the skin and sub-

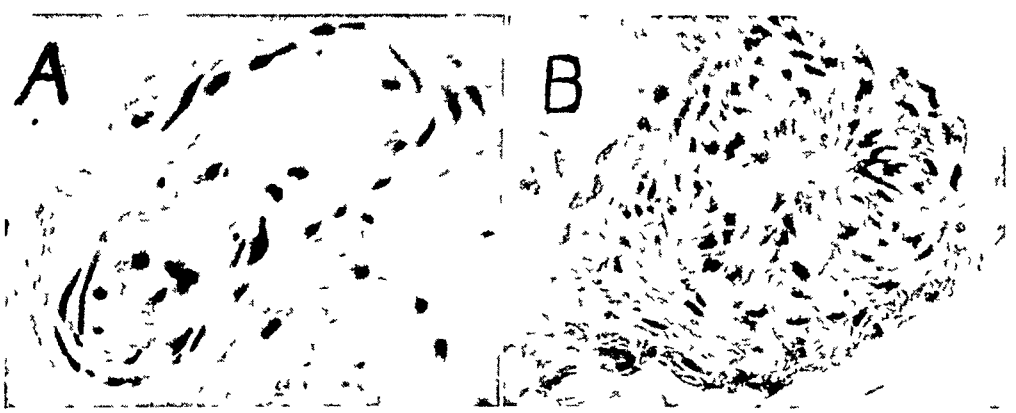


FIG 1 —(A) Photomicrograph of a blood vessel in the skin obtained by biopsy from a patient exhibiting Raynaud's syndrome Note the swelling of the cells of the intima (×600) (B) Photomicrograph of a blood vessel in the tissue from a finger amputated because of gangrene The patient had advanced Raynaud's disease Note the thickening and disorganization of the intima, and the thickening of the media There is marked narrowing of the lumen (×300)

cutaneous tissues, and occasionally of the deeper tissues, including even the bones Scaly necrosis occurring at the tips of the fingers and toes is a typical lesion, and actual gangrene of the superficial layers, skin and subcutaneous tissue may develop

The spastic attacks are of variable severity In some patients there is a bluing of the fingers or toes on exposure to cold with some feeling of numbness On warming, the involved areas become reddened and remain so for a somewhat longer period than the normal This reddening is most marked in persons exhibiting some degree of redness of the skin in the normal state In this group the attacks do not lead to trophic changes even in the vessels them-

* Aided by grants from the Committee on Scientific Research of the American Medical Association, the National Research Council, Division of Medical Sciences, and the Rockefeller Foundation

Submitted for publication June 8, 1937

selves In the more severe cases the spasm is both more pronounced and more prolonged There is marked cyanosis and pallor during an attack The degree of cold required to precipitate an attack is less than in the mild cases Trophic changes, especially necrosis at the tips of the extremities, are frequent In the most severe cases release from spasm may be incomplete for days Attacks may occur at ordinary room temperatures, 70° F or higher Marked trophic changes are almost invariably present

The course of the disease is variable It may remain mild throughout life or it may be present for several years and then disappear entirely The onset of the disease occurs generally in early life at the time of, or shortly after, puberty Manifest evidence of the disease may, however, present itself later, at the time of a pregnancy or during a period in which the individual gives evidence of dysfunction of the reproductive system

Two opposing theories have been presented to explain the mechanism of the spasm of blood vessels The first of these regards it as an expression of hyperfunction of the centers of the sympathetic nervous system Chief support for this theory rests in the symmetrical or bilateral nature of the lesions, the paroxysmal character of the attacks and the knowledge that blood vessels have a vasoconstrictor innervation The second theory regards the etiologic factor as inherent in the walls of the vessels themselves, and not primarily the result of any dysfunction of their innervation

Hyperfunction of any part of the central nervous system, always difficult to establish or disprove, is often found to be an expression of the elimination of an inhibitory mechanism This is exemplified, for instance, in spastic disease of somatic musculature On the basis of experimental evidence, secured from a study made on rabbits, the release from the dorsal root nonmyelinated vasodilators would not be expected to increase appreciably the contraction of the blood vessels, for it has been shown by Bishop, Heinbecker and O'Leary[1] that in these animals reflexly initiated vasodilation over the dorsal roots is not of great magnitude Continued experience with patients exhibiting the Raynaud phenomena has not yielded any consistent evidence of a generalized hyperfunction of the sympathetic nervous system which if present could reasonably be expected to express itself in hyperactivity of sweat glands or pilomotor muscles Hyperfunction of the central nervous system doubtlessly accompanies a generalized increase in metabolism in hyperthyroidism Such an increase is not associated with any tendency to pathologic spasm of peripheral blood vessels Hyperfunction of the nervous system is present in the early stages of certain virus infections but it does not result in spasm of peripheral blood vessels comparable to that seen in spastic vascular states

The fact that the lesions are symmetrical is without conclusive significance as to their origin Indeed, the nervous control of peripheral structures innervated by the autonomic system is primarily unilateral, as it is in the somatic system The disease process involving it might, therefore, be expected to be frequently primarily unilateral The impression that the attacks are expressions of spasmodic activity of the central division of the sympathetic

nervous system was gained by observers who failed to recognize the import of the conditions under which the attacks are initiated, *i e*, on exposure to cold or on emotional excitement Under both circumstances the mechanism whereby constriction is produced is a combined reflex and humeral one Cold produces a reflex excitation of vasoconstrictor impulses to blood vessels and it reflexly produces an increased secretion of epinephrine Emotional activity expresses itself through motor impulses over the sympathetic nervous system which affect blood vessels, sweat glands and pilomotor musculature as well as causing an increased secretion of epinephrine The above reactions were not well understood until recently It should be borne in mind that in a spastic attack these influences will be present, whatever the pathologic condition of the constrictor mechanism

The above analysis is considered to mitigate against the validity of the conception that hyperfunction of the autonomic nervous system is the primary underlying mechanism It cannot be said to disprove it Indeed, reflex activity of the autonomic nervous system is believed by us to be a definite factor in the development of an attack Normally, on exposure to cold, there is a reflex constriction of blood vessels While this may be primarily local as is any somatic reflex, there is usually a generalized response more characteristic of autonomic reflexes in general None of our experimental findings have indicated that the response in persons with spastic vascular disease shows any qualitative difference from the normal There does appear to be a definite quantitative increase in effect This is exemplified through study of the effect of changing environmental temperature on the skin temperature in a normal person and in a person afflicted with Raynaud's disease It is found that the extremities of such persons approach the environmental temperature more than do those of normal persons Denervated blood vessels show a lessened response to temperature stimuli as compared to innervated ones Other evidences of reflex influences in spastic vascular disease have been obtained For instance, in a patient with Raynaud's disease pain developed in all fingers of one hand in the plethysmograph when the air was 21° C, although a thermometer between two fingers, gangrenous at their tips, read 34° C This occurred within five minutes after cooling started, the air in the room being originally at 32° C, and the initial temperature between the fingers 33 5° C Reflex constrictions resulting in pain, therefore, occurred before significant cooling Dipping the elbow of either arm in water at 6° C resulted in homolateral pain in the fingers within two minutes, but not contralaterally (local reflexes), with no measurable change in temperature of the palm or fingers This pain persisted for ten minutes, accompanied by cyanosis, with the arm in the air, at 32° C The patient was put in a cold room at 6° C with both arms wrapped to the shoulder in three inches of cotton batting Pains occurred while the temperature between the fingers was still rising (initial temperature 33 5° C, pain occurred at 34° C, and intense pain at 33 8° C). On coming out of the cold room the pain stopped after four minutes with no detectable change of temperature in the fingers of the

wrapped hand (33.8° C.). The pain was obviously due to reflex spastic constriction and not to changes in temperature of the fingers.

The evidence indicating that there is an etiologic factor inherent in the blood vessel walls, not primarily dependent upon dysfunction of their nerve supply, is twofold. First, is the demonstration that local anesthetization of the nerve supply to a digit during an attack does not relieve the spasm completely, as it should if hyperfunction of the nerves were solely responsible. Partial relief would occur from interruption of the normal impulses responsible for vasomotor tone. Second, is the knowledge that surgical removal of the nerve supply of the limbs which exhibit the Raynaud's syndrome does not prevent the development of attacks in well advanced cases on exposure to cold or during an emotional episode. The explanation offered is that the attacks are now initiated by the action of epinephrine on sensitized blood vessels.

TABLE I

EFFECT OF EXOGENOUS EPINEPHRINE AND INTRAVENOUS GLUCOSE UPON BLOOD VESSELS EXHIBITING THE RAYNAUD SYNDROME

Time	Pulse	Blood Pressure	Condition of Fingers
8 20	100	118/78	No attack
8 21	1 cc. epinephrine subcutaneously		
8 30	106	134/84	Burning of fingers of both hands
8 35	118	138/86	Bluish discoloration, hands feel cold
8 40	113	144/84	Burning pain
8 42	50 cc. 50% glucose intravenously		
8 45	115	148/85	Burning pain
9 00	98	148/78	Less pain—fingers feel warmer
9 05	98	135/72	Hands almost as at start
9 15	96	120/68	Hands feel as at start

TABLE II

EFFECT OF INSULIN ADMINISTRATION UPON BLOOD VESSELS EXHIBITING THE RAYNAUD SYNDROME

Time	Blood Sugar	Condition of Fingers
11 00	54 mg. %	Fingers free of spasm
11 05	15 units insulin subcutaneously	
11 45	46 mg. %	No change in fingers
12 15		Severe pain in all fingers—fingers cold and cyanotic—no sweating
12 30	26 mg. %	Fingers very cyanotic—some cyanosis of whole arms
1 00		No change
2 00	27 mg. %	Fingers still cyanotic and painful
2 30	Meal of eggs, bread, sweetened lemonade	
2 40		Pain disappearing Cyanosis not so marked
2 50		Fingers free of spasm

That such sensitivity to circulating epinephrine exists, in well established cases of Raynaud's disease exhibiting intact innervation, has been shown by

us in studies on six clinical cases (Table I) With doses of epinephrine ranging from 0 2 to 1 0 cc (1 1,000 Parke-Davis), average 0 5 cc it is possible to initiate an attack in such diseased extremities The spasm frequently involves the part of the extremity quite central to the region showing obvious involvement during an attack initiated by cold The unaffected extremities under such circumstances showed no unusual changes indicating a definitely increased sensitivity of the involved areas In well established cases the attacks could be induced in a warm room by giving 10 to 15 units of insulin subcutaneously (Table II) It was possible to relieve an attack with dramatic suddenness by the intravenous administration of 20 per cent glucose The latter fact, again, definitely suggests that there is no alteration in nervous tone to account for an attack, because the injection of 20 per cent glucose has not been demonstrated to effect vasomotor activity The amount of fluid injected is not sufficient to explain the opening up of constricted vessels on the basis of increased amount of circulating fluids It is only possible to explain the effect as a consequence of circulating epinephrine After denervation of the pupil in cats, sensitivity to epinephrine is increased 20 to 40 fold (Heinbecker[2]) Grant,[3] Hampel,[4] and others, have shown that denervated blood vessels show a definite increased response to exogenous epinephrine

Nature of the Local, Inherent Etiologic Factor—The demonstration that vessels subject to abnormal spasm on exposure to cold are sensitized to epinephrine suggests that the local, inherent etiologic factor is similar to that developed in denervated vessels That it is not due to denervation follows from the fact that cases may recover entirely Investigations, reported by Heinbecker,[2] have shown that this is to be regarded as a trophic or metabolic change, mild degrees of which may be produced in smooth musculature, generally by thyroid feedings and by hypophysectomy It is diminished by thyroidectomy, gonadectomy and adrenalectomy Hyper- or hypodynamic response of such hormonal imbalance is more readily demonstrated in tissue already sensitized by denervation than in normal tissue Examination of such tissues by routine cytologic methods fails to reveal any definite structural change There is no alteration in salt content or arrangement as revealed by spectrographic or micro-incineration methods The fat content likewise is apparently unaltered The fact that there is no demonstrable cytologic change in the diseased blood vessel is not without parallel when we consider allergic states where violent reactions in smooth musculature occur without any demonstrable pathologic change Heinbecker has presented evidence, not inconsistent with the interpretation, that in sensitized tissues there is an accumulation of epinephrine or of a substance upon which it acts

The demonstration that change in smooth musculature, similar to that induced by denervation, may follow from hormonal imbalances, invites the suggestion that this may be the mechanism responsible for initiating a local, inherent etiologic factor in persons exhibiting the Raynaud syndrome Such an imbalance does not in itself produce Raynaud's disease in animals One is forced, therefore, to infer a fundamental constitutional or metabolic dis-

order, or tendency to such a disorder, in the blood vessels of certain persons This, in itself, may lead to spastic disease but it is frequently made manifest only through hormonal imbalances such as occur at the time of puberty, pregnancy, *etc* Manifestation of the local etiologic factor is usually in the extremity where circumstances of circulation and innervation are most favorable for evidence of impairment

Discussion—Spastic vascular disease may be regarded as a constitutional or trophic change in the walls of blood vessels, which makes them respond more than normally to reflexly initiated vasoconstrictor impulses and to circulating epinephrine The reflexes and the epinephrine secretion being stimulated by exposure to cold or by emotional excitement Cold itself plays a minor rôle, if any, as a *direct* constrictor agent in the typical spasm

Treatment of spastic vascular disease should, ideally, be directed toward the prevention or elimination of the local etiologic factor This, in the present state of our knowledge being an impossibility, treatment must concern itself, primarily, with an elimination of the exciting factors When such measures are ineffectual, then means of preventing the attack by modification of the innervation and tone of the involved blood vessels are warranted in addition

Elimination of the exciting factor, cold, can be accomplished by the wearing of proper protection for the hands and feet This will suffice in the mild cases If it is possible for the individual to live in a warm climate he may under such circumstances remain free from attacks Attacks in the emotionally unstable may be lessened by the institution of a proper psychotherapeutic regimen

When attacks develop on exposure to a temperature of 70° F, surgical measures designed to diminish the tone of the involved vessels and to eliminate them from the influence of constrictor nerve impulses are warranted Such effects may be accomplished by sympathetic denervation of the involved extremities Two courses are open One the institution of preganglionic and the other of postganglionic denervation Postganglionic denervation is permanent There can be no question of regeneration, and it will eliminate all possible reflexes by constrictor impulses, but it leads to a sensitization to epinephrine This, in itself, may result in a constriction of the blood vessels on exposure to cold or on emotional excitement, because under such circumstances epinephrine is secreted In about one-half the clinical cases operated upon temporary relief only is accomplished and in many instances attacks still occur The diminution in some cases, brought about by denervation, is only temporary Experimental investigation of the duration of decreased tone after postganglionic denervation has yielded results which show that such altered tone does not last for more than 10 to 12 months and may be of much shorter duration (Heinbecker) After this time the only benefit to be derived from denervation is the elimination of reflexly instituted constrictor impulses Preganglionic denervation of the cat's iris sensitizes it to only about 10 to 20 per cent of the degree of sensitization produced by postganglionic denervation (Heinbecker) The duration of the decrease in tone in de-

nervated cat's iris is about one-half that resulting after postganglionic denervation (Heinbecker) If regeneration be prevented by proper technic the reflexly exerted constrictor impulses will be eliminated permanently It is felt that because of the lessened sensitization to epinephrine resulting from preganglionic denervation it is the procedure of choice This idea is supported by the fact that clinical results reported after surgical interference in cases in which the lower extremity was affected were more satisfactory than in those involving the upper extremity The better results in the lower extremity cases are attributed to the fact that the operative procedure generally employed is one in which the preganglionic fibers for the most part are interrupted (White[5])

The surgical procedure recommended in instances where the upper extremity is involved would be one which would denervate the preganglionic fibers coming from the first, second and third thoracic nerves An operative procedure recently described by Telford,[6] and by Smithwick,[7] in which they advise the resection of a portion of the second and third thoracic nerves from the spinal ganglion outward for one and one-half inches, and a section of the sympathetic trunk below the third ganglion, may have the disadvantage of incompleteness By this procedure the preganglionic fibers from the second and third thoracic level, and from levels below this, are eliminated Preganglionic neurons from the first thoracic level, and above, are not eliminated The number of fibers derived from these sources in the cat are considerable (Kuntz, Alexander and Furcolo[8]) If it were possible to eliminate the first thoracic nerve the procedure would doubtless be more efficient, but this is not possible because the first thoracic nerve is an important motor nerve to the upper extremity Under the circumstances it seems advisable to advocate the cutting of the rami communicantes from the first thoracic nerve also This, of course, adds the complications associated with Horner's syndrome Operation upon the lower extremity consists in removal of the second and third and sometimes the fourth lumbar ganglia By this procedure preganglionic fibers to the lower extremity are interrupted Postganglionic neurons for the lower extremity lie, for the most part, in the fifth lumbar, and first and second sacral ganglia In this procedure the degree of senitization is minimized The end-results reported by all operators are quite satisfactory

CONCLUSIONS

Inasmuch as spastic vascular disease is not primarily dependent upon the dysfunction of innervation but to a local, inherent, trophic etiologic factor, there will always be cases in which the disease process will progress to a point where sensitization to epinephrine, in itself, will be enough to bring about an attack whenever an unusual amount is secreted despite the elimination of other influences Then too, when the disease is progressive, changes leading to occlusion of vessels always develop Surgical procedures cannot be expected to greatly improve those cases in which occlusive disease is already present to a marked degree at the time of operation Future efforts should

be directed to search for the cause of the constitutional derangement apparently present in these cases

REFERENCES

[1] Bishop, G H, Heinbecker, P, and O'Leary, J L Am Jour Physiol, 106, 647, 1933
[2] Heinbecker, P Am Jour Physiol, 120, 401, 1937
[3] Grant, R T Clin Sci, 2, 1, 1935
[4] Hampel, C W Am Jour Physiol, 3, 3, 1935
[5] White, J C The Autonomic Nervous System New York, Macmillan Company, 1935
[6] Telford, E D Brit Jour Surg, 23, 448, 1935
[7] Smithwick, R H Annals of Surgery, 104, 339, 1936
[8] Kuntz, A, Alexander, W F, and Furcolo, C L Complete Sympathetic Denervation of the Upper Extremities Annals of Surgery, 107, 25–31, January, 1938

NEOPLASMS OF THE ABDOMINAL WALL

WITH SPECIAL REFERENCE TO MALIGNANT "IMPLANTATION" TUMORS

JOSEPH A LAZARUS, M D

NEW YORK, N Y

KLOT,[7] in 1921, collected 408 cases of tumors involving the abdominal wall, of which 248 were fibromata, 67 fibrosarcomata, 17 fibromyxomata, 60 sarcomata, one endothelioma, one angioma and one angiosarcoma Since then an occasional case report has found its way into the literature from time to time A survey of the Index Medicus shows but few instances of adenocarcinoma present in the abdominal wall unassociated with some type of fistulous communication with, or direct extension from, an abdominal organ harboring carcinoma

To indicate the relative rarity of malignant tumors of the abdominal wall, Gurlts,[5] out of a total of 16,637 cases of malignant tumors, found only 27 malignant tumors of the abdominal wall, of which there were 13 carcinoma[ta and 14 sarcomata Dvorak,[4] reviewing the records of 28,013 admissions at the University Hospital of the University of Minnesota, between 1910 and 1923, found only nine cases of abdominal wall tumors, of which number there were only two carcinomata and one sarcoma arising by direct extension

Vosburgh[17] classifies abdominal tumors as

(1) Superficial (sebaceous cysts, papillomata and cutaneous moles and lipomata)

(2) Fibromata (hard and soft), the harder arising from the aponeuroses and tendinous insertions, while the softer ones take origin in the subcutaneous tissues and in the fibrous sheaths of vessels and nerves

(3) Desmoids are fibromata in which the constituent elements have a special arrangement and arise usually in the anterior or lateral abdominal wall, and in about one-half of the cases are associated with the rectus muscle or its sheaths, usually the posterior Desmoids are seven times more frequently encountered in women than in men These tumors are usually small although they may grow to large size, are smooth and ovoid, with their long axes parallel to the long axis of the rectus muscle On section the cut surface is of a glistening white color with fibers interwoven Microscopically the tumors may be poor or very rich in cellular elements, and are poor in blood supply, which makes them liable to early necrosis

(4) Carcinoma—Carcinomata of the abdominal wall fall into two groups, namely (a) Those involving the abdominal wall proper, and (b) those arising from the umbilicus Primary carcinoma of the abdominal wall proper, while possible, must be extremely rare, since, with the exception of those cases already discussed, no such case has been found by the writer in a re-

Submitted for publication June 28, 1937

view of the literature Secondary carcinomata in the abdominal wall occur (a) By direct extension from an adjacent intra-abdominal organ, (b) through a fistulous communication with a hollow abdominal organ harboring a carcinoma, and (c) by true metastasis from a distant organ or by direct implantation at the time of a previous operation

Carcinoma of the umbilicus is not a rare phenomenon and may occur either as a primary or as a secondary growth Squamous carcinoma is the most frequent primary carcinoma of the umbilicus and usually arises from epithelial remnants of the urachus or omphalomesenteric duct Columnar cell carcinoma of the umbilicus usually indicates a secondary growth from an intra-abdominal organ

(5) Sarcomata in the majority of cases represent a malignant transformation of preexisting benign tumors, such as a nevus or a fibroma There are some tumors which start as sarcomata

(6) Melanosarcoma which is generally a part of a general sarcomatosis, and finally

(7) Endometrioma (not mentioned by Vosburgh[17]), or a transplant to the uterine mucosa during the period of menstruation found in the abdominal wall particularly after operations on the uterus, especially caesarean section

Since the case herein cited is that of an adenocarcinoma of the abdominal wall occurring 13 years after the removal of an apparently benign ovarian cyst, it might be well to note that as far as the writer was able to ascertain, there are only 14 references in the literature (six collected by Dvorak[4] and eight by Polano[14]) in which the presence of a carcinoma of the abdominal wall, following the removal of a supposedly benign ovarian cyst, did not arise by direct extension from an abdominal organ harboring carcinoma which was adjacent to that portion of the abdominal wall, or in the case of a hollow viscus affected with carcinoma, with some type of fistulous communication

An unusual case reported by Dvorak, and simulating the one about to be described, was that of a woman, age 69, who 15 years previously had had the uterus, left ovary and tube together with a cyst and two tumors of the uterus removed Following the operation the abdominal wound became infected so that healing was delayed The pathologic report of the specimen was unfortunately not stated For 13 years the patient was apparently well, she then noted a lump in the left lower abdominal quadrant, which, during the next two years, grew to the size of a football, and was accompanied by sharp shooting pains The tumor extended from a point 5 cm below and 9 cm to the left of the umbilicus to a point on the pubic crest 3 cm to the right of the midline, was slightly tender to palpation and appeared to be imbedded in the musculature of the abdominal wall The skin was not adherent to the mass A diagnosis of desmoid of the rectus sheath was made and removal advised Adenopathy was absent

The tumor, including a large part of the left rectus muscle and its anterior sheath, was removed The pathologic report was adenocarcinoma, made up of alveolar glands lined by columnar epithelial cells Three courses

of deep roentgenotherapy were given, followed later by implantations of radium to a local recurrence The patient developed a large incisional hernia She lived about five years after operation, succumbing finally to local and distant metastases to the vertebrae Postmortem examination revealed two fistulous communications, one with the ileum and the other with the transverse colon There were no metastases in the peritoneum, nor in the pleural and pericardial cavities The lymph nodes were also free, but metastases were found in the fourth and fifth lumbar vertebrae The local recurrence consisted of a mass 5×2 cm , consisting of many atypical and poorly formed alveolar structures lined by tall columnar cells The findings suggested a papillary cystadenocarcinoma of ovarian origin

Although there was no proof to substantiate it, the origin of this tumor was believed to be an implantation of a portion of the apparently benign ovarian cyst into the abdominal wall incision at the time of the operation performed 20 years previously

In 1864, Wagner described a case of a patient who developed three subcutaneous cystic tumors, one below the left breast, one in the right axilla and one in the left flank following frequent tapping of the abdomen for ascites resulting from a large intra-abdominal, benign, papillary, serous cyst of the left ovary At autopsy the subcutaneous cysts were of identical histologic structure to that found in the affected ovary

Jaquet[6] (quoted by Dvorak) reported a case of a dermoid of the ovary removed in 1874, and 17 years later the patient developed a malignant tumor, measuring 15 cm in diameter, in the abdominal wall

Olshausen[12] reported a case of a patient, 46 years of age, who 21 years previously had a left oophorectomy performed Seventeen years later he removed a tumor from the right side of the abdominal wall above the umbilicus Histologically the character of the tumor was that of a benign papillary cystadenoma of the ovary Olshausen was of the opinion that this tumor resulted from an implantation in the abdominal wall during the course of the oophorectomy performed 17 years previously

This same author also reported a case of a woman, who at the age of 29 had a bilateral oophorectomy performed for papillary cysts About 20 years later she noticed a mass in the right side of the abdomen which had progressively increased in size The tumor was found situated in the abdominal wall and when removed was diagnosed, from its gross appearance, as undoubtedly carcinoma No histologic report appears in the protocol Just as in the previous case, Olshausen believed this tumor to have occurred as a result of implantation at the time of the oophorectomy, since the tumor was present in the scar of the previous operation

Tauber[16] reports that Schneutgen,[15] up to 1918, was able to collect only eight cases from the literature of benign ovarian tumor implantations in the abdominal wall, and added one case of his own

Bland-Sutton[1] performed a hysterectomy and bilateral oophorectomy for what appeared to be benign papillary ovarian cysts Six years later the patient

noticed a rapidly growing tumor in the right side of the sternum in the second intercostal space, which promptly recurred after removal and eroded the entire manubrium Histologically this tumor was identical with the primary tumors of the ovaries At autopsy there was no recurrence in the abdomen

An interesting case is reported by Tauber of a woman who, in 1919, was explored for ascites, but apparently no tumor found Two years later with recurrence of ascites, celiotomy revealed bilateral papillary ovarian cysts, with three small cysts on the anterior parietal peritoneum below the umbilicus These were removed along with both ovaries Histologically there was no evidence of malignancy Five years later she returned with a cystic tumor in the anterior abdominal wall around the umbilicus, which proved to be a malignant ovarian cyst Tauber also reports that Lang[8] removed a pseudomucinous cyst from the left ovary of a patient, age 30, and after two months an adenocarcinoma developed in the scar of the previous celiotomy

Taking the ten cases collected by Dvorak, including the one he reported, along with the case herewith described, brings the total of cases, in which apparently benign ovarian cysts were followed at varying intervals by benign or malignant tumors of ovarian origin in the abdominal wall, to 11 cases Of these 11 cases, the abdominal wall tumor was found malignant in seven, and benign in four The longest interval between the removal of the original tumor and the discovery of the abdominal wall tumor was 21 years, while the shortest interval was two months In six of the 11 cases, however, the interval was over ten years While in all of these 11 cases the primary tumor of the ovary was apparently benign, Cullen[3] collected nine cases of malignant abdominal wall tumors following extirpation of malignant ovarian tumors

In addition to the ten cases discussed by Dvorak, Polano collected seven cases, and added one of his own, of malignant abdominal wall tumors occurring in the scars of previous celiotomies for the removal of apparently benign ovarian cysts At autopsy, his own case was found to have a carcinoma of the stomach, and Polano believed that this was the primary growth Unfortunately out of the seven case reports which he collected from the literature, necropsy was obtained in only one (Pfannenstiel[13]), and in this case the autopsy failed to disclose any intra-abdominal evidence of malignancy The absence of concrete evidence of the existence of an intra-abdominal malignant focus in six out of eight cases led Polano to the conclusion that in spite of the fact that oophorectomies for apparently benign ovarian cysts antedated the finding of malignant tumors in the abdominal wall, these tumors might have had nothing at all to do with the original ovarian cysts, but might be metastatic tumors developing from some preexisting malignant tumors of other abdominal organs present but overlooked at the time of the original operation, or having developed subsequent to the oophorectomy

In order to understand the mysterious circumstances of malignant abdominal tumors following the removal of apparently benign primary ovarian tumors, it might be well to refer to the excellent paper of Mayfield[11] in 1927 From an analysis of 100 cases, Mayfield comes to the conclusion that the

size of the cysts is no indication as to the character of their pathology and that often both benign and malignant features were found present in the same specimen This same author noted various degrees of malignancy in the same type of tumors, which might explain the variations in the time interval between the removal of the original cyst and the appearance of the abdominal wall tumor He also looks upon bilateral, papillary ovarian cysts as always suspiciously malignant, even though the microscopic findings may not confirm the suspicion, since it is so easy to overlook a small area of malignancy unless complete serial sections are made and examined of the removed specimen So that the removal of a cystic tumor of the ovary which to all intents and purposes has been judged benign from microscopic and gross examinations may still have been malignant, and the long interval existing between the removal of the original ovarian tumor and the finding of the malignant abdominal wall neoplasm may be explained on the ground that the grade of malignancy of the original tumor was extremely low

Instances of abdominal wall implants of other types of benign tumors following some type of operation upon the female generative organs such as fibromyomata and adenomyomata, also designated endometriomata, have been frequently described in the literature (Brewer[2], Cullen[3], Mahle and MacCarty[10], Lochrane[9], and others)

Diagnosis—To determine whether a tumor is situated in the abdominal wall or beneath it, the patient, lying on her back, is instructed to sit up unaided In so doing, the abdominal muscles are contracted and should the tumor become invisible and nonpalpable, it is certain that it is not situated in the abdominal wall Should the tumor, however, still remain palpable and immovable, even though it can no longer be seen, with the patient's muscles contracted, it can be stated that it is situated in the abdominal wall An intra- or subcutaneous tumor does not change at all during the maneuver The exact nature of the abdominal wall tumor can only be determined by biopsy

Treatment—Benign tumors are treated by extirpation In dealing with a definitely malignant tumor of this type, treatment becomes a definite surgical problem Since one can only be reasonably certain of whether a malignant tumor of the abdominal wall is primary or secondary to some intra-abdominal organ, exploratory celiotomy is indicated in all cases to establish the presence or absence of a malignant intra-abdominal tumor, and even then one cannot always with absolute certainty rule out the presence of such a growth A negative exploration then leaves the operator with the problem of what to do with the abdominal wall tumor In the event the tumor is a small one, extirpation should be effected and the defect in the abdominal wall repaired wherever possible With tumors involving a large portion of the abdominal wall, one should proceed cautiously before deciding upon extirpation One must reason in such cases that a tumor which has grown large enough to involve a large portion of the abdominal wall must already have given rise to metastases Extirpation then would result in a large incisional hernia with-

out any further compensating advantages over the employment of irradiation It is the writer's opinion that malignant tumors invading large segments of abdominal wall had best be considered beyond the scope of radical removal, and treated with deep roentgenotherapy or radium

Case Report—S Z, female, age 42, single, presented herself November 28, 1936, complaining of menorrhagia, pain in the pelvis and a burning sensation in the lower abdomen of three months' duration Her mother had died of cancer, but she did not know the organ involved

Her menstrual history was entirely normal Menstruation commenced at the age of 13, was regular every 28 days, lasted three to four days, and was unassociated with any pain Thirteen years previously she was operated upon for a "cyst of the left ovary" which was considered benign Unfortunately, no record could be found of the histologic findings of the specimen removed Since the removal of the ovary she noted a slightly increased growth of hair on the face, a deepening of the voice and diminished libido Otherwise she felt perfectly well

Three months previously she noted an increase in the menstrual flow There was no metrorrhagia, but she complained of a dull, intermittent aching pain deep in the pelvis and a burning sensation in the lower abdomen There was no loss of weight, no anorexia or symptoms referable to the gasto-intestinal tract The rest of the history was entirely irrelevant

Physical Examination revealed a well developed, robust patient Blood pressure 118/90 Situated in the lower abdomen to the right of the midline, and extending from the symphysis pubis to the level of the umbilicus, there was a firm, hard, irregular mass, neither tender nor movable The mass could be felt when the patient was asked to sit up from a recumbent position Directly over it was a long right lower rectus scar of the previous operation Vaginally one could not make out any relationship between the mass and the uterus which felt perfectly normal

A scout roentgenogram of the pelvis revealed an indefinite small shadow situated over the sacrum which was thought to be a calcified lymph node Roentgenologic examination of the genito-urinary tract was negative A barium enema likewise showed no abnormalities Uranalysis was negative Blood count Hemoglobin, 88 percent, red blood corpuscles, 4,320,000, white blood corpuscles, 5,200, morphonuclears, 55 per cent, lymphocytes, 34 per cent, rods, 7 per cent, monocytes, 4 per cent

A tentative diagnosis of abdominal tumor not associated with the uterus was made, and exploratory operation advised

Operation—December 3, 1936 Under spinal anethesia, a three and one-half inch midsuprapubic incision was made Upon extending the incision through the subcutaneous fat, it was immediately noted that the tumor involved the abdominal wall and extended from the symphysis pubis up to the level of the umbilicus, involving both sheaths and body of the right rectus muscle The peritoneum was opened by retracting the tissues to the left and incising through the left rectus muscle and peritoneum Exploration failed to reveal any involvement of the pelvic or abdominal viscera With the hand in the peritoneal cavity, the affected portion of the abdominal wall was exposed and found to simulate an extensive, convex, pancake-like tumor of cartilaginous-hard consistency, extending from the symphysis pubis to the umbilicus, and from the linea alba laterally to a line drawn from the crest of the ilium to the midportion of the twelfth rib It was of a yellowish-white color and the most central part of the growth was of a softer consistency than the peripheral portions A portion of the tumor was removed for biopsy

Pathologic Examination—(Dr A A Eisenberg, Sydenham Hospital) The specimen measured 3x1 5 cm The external surface was of a grayish-white color and the consistency of the tissue was firm On section the tissue was uniformly white

Sections show numerous carcinomatous areas scattered throughout the entire sections, with many of them arranged in the form of small acini The cells show numerous mitotic figures and anaplastic changes Occasionally one sees a group of small acini presenting as adenomata Between the acini there is a moderate lymphocytic infiltration and a few hemorrhagic areas (Figs 1 and 2)

Diagnosis—Adenocarcinoma Dr Francis Carter Wood who examined the slide believed that the specimen could very well represent ovarian tissue and noted a group of large cells extremely suggestive of arrhenoblastoma

Postoperative Course—Following her discharge from the hospital the patient was placed upon intensive deep roentgenotherapy resulting in considerable shrinkage of the



FIG 1—Photomicrograph showing the arrangement of cells particularly indicating groups of cells suggesting arrangement seen in arrhenoblastoma of the ovary (×125)

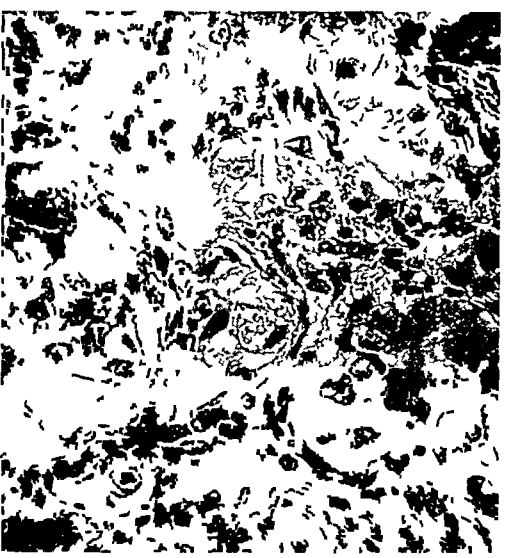


FIG 2—Photomicrograph indicating the character of the cells slightly suggestive of cells seen in arrhenoblastoma (×725)

tumor Yet, in spite of the reduction in size of the original growth, she developed a large hard node in the left groin which is responding to irradiation Her general condition to date is good

SUMMARY AND CONCLUSION

Carcinomatous tumors of the abdominal wall unassociated with fistulous communications with, or direct extension from, an abdominal organ harboring carcinoma are extremely rare A careful review of the literature reveals seven cases including the author's case in which, following the removal of an apparently benign cyst of the ovary, after an interval ranging from two months to 21 years, a carcinomatous tumor occurred in the abdominal wall either in the scar of the original operation or close to it, apparently without any other intra-abdominal involvement (Dvorak, 6, Lazarus, 1) Polano collected seven cases of malignant abdominal wall tumors occurring in the scars of previous celiotomies for the removal of apparently benign ovarian cysts and added one of his own At postmortem, however, his own case was found to have a carcinoma of the stomach, which the writer believed was the growth responsible for the abdominal wall tumor Of the seven cases which he col-

lected from the literature, autopsy was performed in only one and this one failed to reveal any evidence of intra-abdominal malignancy The remaining six cases without postmortem evidence led Polano to the conclusion that one cannot with certainty state that a given intra-abdominal carcinoma, even though histologically resembling the architecture of an ovarian cyst that had previously been removed from the same patient, was secondary to such a cyst, since one might have overlooked a malignant growth in another intra-abdominal viscus which had been present at the time of original operation or had developed subsequent to the oophorectomy In view of the fact that, of the ten cases reported by Dvorak and also the one reported by the writer, autopsies were obtained in only three, and in none of these was there found any intra-abdominal pathology other than that occurring in the ovary, it might be justly argued, with Polano, that the failure to confirm by complete autopsy the presence or absence of a malignant growth elsewhere in the body invalidates, to a certain degree, the conclusion that a malignant tumor of a supposedly benign ovarian cyst is the result of an implantation taking place at the time of the original operation That such a phenomenon is possible, however, has been definitely established by the few autopsies that have been obtained and reported Furthermore, it is difficult to understand the underlying reason of a malignant abdominal wall tumor occurring after the removal of a benign cystic tumor of the ovary unless we assume the possibility of such a tumor possessing low grade malignant possibilities at the time of the original operation

Biopsy is the only reliable means of determining the nature of a tumor of the abdominal wall The prognosis is always bad Treatment of small tumors consists of thorough abdominal exploration followed by extirpation of the growth and deep roentgentherapy In the large tumors extirpation is not advised since removal of large sections of abdominal wall always leads to serious postoperative herniation, without in any way adding to the life expectancy of the patient, which is not offered by the less mutilating use of irradiation therapy

A case is herewith presented of an extensive adenocarcinoma of the abdominal wall, in the region of the scar of the previous operation, in a young woman who, 13 years previously, had had an oophorectomy performed for a supposedly benign ovarian cyst Exploratory celiotomy failed to reveal the presence of any intra-abdominal pathology The treatment administered in this case was deep roentgentherapy

REFERENCES

[1] Bland-Sutton, Sir John Tumors, Benign and Malignant, pp 622–626, 1922
[2] Brewer, G E Typical Fibromyoma of Abdominal Wall Following Hysterectomy Annals of Surgery, 74, 1921
[3] Cullen, T S The Umbilicus and Its Diseases Philadelphia, W B Saunders Company, 1916
[4] Dvorak, H Implantation Malignancy of the Abdominal Wall Surg, Gynec, and Obstet, 50, 907–913, 1930

[5] Gurlts Quoted by Zweifel and Payr Die Klinik der Boesartigen Geschwuelste Leipzig S Hirzel, 3, 1924
[6] Jaquet Quoted by Dvorak
[7] Klot, B von Ueber bindegewebige Bauchdecken-tumoren und ihre klinische Bedeutung in Anschluss an einen Fall von Fibrom in einer Appendektomienarbe Beitr z klin Chir, 123, 28, 1921
[8] Lang Quoted by Tauber
[9] Lochrane, C D Endometrial Adenoma of Abdominal Wall Following Ventrosuspension of Uterus Jour Obstet and Gynec, Brit Emp, 3, 213, 1923
[10] Mahle and MacCarty Ectopic Adenomyoma of Uterine Type Jour Lab and Clin Med, 5, 221, 1920
[11] Mayfield, A L Papillary Cystadenoma of the Ovary, Clinical and Pathologic Analysis of 100 Cases Northwest Med, May, 1927
[12] Olshausen, R Impfmetastasen der Carcinome Deutsche med Wchnschr, p 750, 1902 Idem Ueber Bauchwandtumeren especiell ueber Desmoide Ztschr f Geburtsh u Gynaek, 41, 271, 1899
[13] Pfannenstiel Ueber Karzinombildung nach Ovariotomien Ztschr f Geburtsh, 28, 349
[14] Polano, Oscar Zur Entstehung maligner Bauchdecken-tumoren nach Entfurnung gutartiger Eierstocksgeschwuelste, p 416 Ztschr f Geburtsh u Gynaek, p 56, 1905
[15] Schneutgen Quoted by Tauber
[16] Tauber, R Maligne Degeneration von Implantationen in den Bauchdecken nach Exstirpation Papillarer Ovarialtumoren Zentralbl f Gynaek, 51, 1505, 1927
[17] Vosburgh, A S Johnson's Operative Therapeutics, 3, 764–765
[18] Wagner, E Fall von mehrfachen Cysten des Ovariums, Peritonaeums und des Subcutanen Bindergewebes Arch f Heilk, 5, 92, 1864

BLOOD LOSS IN NEUROSURGICAL OPERATIONS

J C White, M D, G P Whitelaw, M D, W H Sweet, M D, and E S Hurwitt, M D

Boston, Mass

From the Surgical Services of the Massachusetts General Hospital and the Surgical Laboratories of the Harvard Medical School at the Massachusetts General Hospital, Boston, Mass

The purpose of this paper is to call attention to the large volume of blood lost in major neurosurgical operations in contrast to the comparatively moderate amounts lost during operations on the abdominal viscera, the thorax, and the extremities In another article[1] water balance in neurosurgical patients has been considered Both communications point out certain aspects of blood loss and water balance in brain operations which must be understood and skillfully handled in order to avoid serious disturbances in the blood and tissue fluids

Gatch and Little,[2] and also Coller and Maddock,[3] have shown that in the average celiotomy it is unusual for hemorrhage to exceed 200 cc In their determinations they record no statistics on neurosurgical operations,* and in a search through the literature we have been unable to find any such data It is, therefore, of interest to point out that in extensive craniotomies a blood loss of from 500 to 1,200 cc is quite usual, while in unusually vascular tumors hemorrhage in excess of one and one-half liters may occur Many neurosurgeons, fully conscious of the importance of hemostasis, are unaware of the amount of blood which is removed, so unostentatiously, by the suction apparatus and which is absorbed by the multitude of small pledgets This was brought out in our early measurements when the surgeon's rough estimate of the amount of blood lost was compared with the figures obtained from the hemoglobin content of the drapes, pledgets, and contents of the suction bottle

In addition to this excessive loss of blood, we have shown[1] that a patient undergoing an operation for an intracranial tumor may lose up to 1,000 cc of fluid from his skin and lungs This also is, at times, in excess of the loss of water vapor which takes place in other surgical operations In the latter, careful hemostasis is essential to prevent postoperative hematomata and poor wound healing But in many intracranial and in certain spinal cord operations bleeding is so profuse that the surgeon must use every resource at his command to keep it within a safe limit

Observations—The determination of blood loss during operation was made by the method of Gatch and Little[2] The hemoglobin, which is extracted from the drapes and cotton pledgets by rinsing them thoroughly

* With the single exception of a laminectomy in a case of fracture of the spine with a blood loss of 672 cc (Gatch and Little[2])

Submitted for publication August 16, 1937

in a known amount of water is converted to acid hematin by the addition of hydrochloric acid The color intensity of the unknown sample is then measured against a standard containing 1 cc of the patient's blood obtained preoperatively, diluted to 100 cc, and acidified The calculated volume of blood lost is probably from 5 to 10 per cent less than the actual amount because of the difficulty of recovering all the hemoglobin from the dry goods, instruments, and the floor of the operating room Since this work has been completed, Pilcher and Sheard[4] have described a more sensitive method of quantitatively estimating blood loss in which the hemoglobin content is measured by a spectrophotometric and photelometric method, but for the purposes of this investigation the method of Gatch and Little should be sufficiently exact

Table I shows the amount of blood lost in a series of 37 standard neurosurgical operations This should be compared with the data in Table II obtained by Gatch and Little[2] and by Coller and Maddock[3] in a series of general surgical operations The greatest loss of blood recorded in Table II, 1,272 cc, occurred in a radical resection for carcinoma of the breast Our maximal blood loss, 2,150 cc, took place during the removal of a large frontoparietal meningioma (Patient 5) The patient was given two transfusions, and made an uneventful recovery The other two patients (Nos 2 and 29) who lost over two liters of blood did not survive In Patient 2, a meningioma of the cribriform plate, death appeared to be related to the hemorrhage and shock In Patient 29, however, the hemorrhage was well compensated* and shock did not develop Death in this case was presumably due to cerebral injury with consequent hyperthermia, but no autopsy was permitted In spite of the fact that 15 of these patients lost over a liter of blood, only two developed severe postoperative shock, and only one death was attributable to a reduced blood volume The reason a greater loss of blood can be tolerated in intracranial than in intra-abdominal operations will be considered later in the discussion In no instance where an extensive craniotomy was performed was the loss of blood less than 487 cc Where no resection of brain tissue was carried out, the hemorrhage occurred mainly during the closure of the scalp When the skull is not excessively vascular, careful hemostasis can reduce the amount of bleeding during the incision of the scalp and turning down the bone flap to an amount not in excess of 100 cc, but bleeding when the hemostats are removed and the stitches are placed in the galea is more difficult to control

To summarize the volumes of blood lost during operation by three different surgeons, it was found that in simple craniotomies, where nothing more than an exploration and cerebral biopsy was carried out, the average loss amounted to between 500 and 900 cc (Table I) In patients with

* The term "compensation," as applied in this article to the reaction of the body to hemorrhage, does not imply restoration of the red blood corpuscles or plasma volume It simply means the maintenance of a relatively adequate supply of blood to the heart and vital organs through the hemostatic activity of the sympatho-adrenal mechanism

TABLE I

BLOOD LOSS AND EARLY POSTOPERATIVE REACTIONS IN A SERIES OF 37 NEUROSURGICAL OPERATIONS

Transfusions averaged 500 cc of citrated blood

Patient	Age	Operation	Anesthetic	Time—Hours	Blood Loss Cc	Shock	Transfusion	Postoperative Course
1	47	Partial removal of left frontoparietal glioblastoma multiforme	Local	2¾	1,449	0	0	Died in 17 hours Autopsy showed herniation of cerebellum into foramen magnum
2	56	Exploration and decompression of meningioma of cribriform plate	Local	3¼	2,023	++	2	Died in 40 hours probably from intracranial hemorrhage No autopsy
3	14	Exploration for epilepsy	Avertin and local	2¼	964	0	0	Uneventful
4	24	Excision of cerebral cicatrix for epilepsy	Local and evipal	3	1,456	0	1	Uneventful
5	26	Removal of large frontoparietal meningioma	Local	2	2,150	++	2	Uneventful
6	25	Negative cerebral exploration	Local	2¼	542	0	0	Uneventful
7	20	Bone flap to evacuate subdural hematoma	Local and ether	2¼	599	0	0	Uneventful
8	37	Resection of meningioma of tuberculum sellae	Local	2½	574	0	0	Patient did well at first but then slipped into coma and died on the ninth day
9	15	Laminectomy for extreme scoliosis with cord compression	Avertin and ether	1¾	334	0	0	Uneventful
10	51	Partial removal of acoustic neuroma	Local	4½	638	0	0	Died on second day Cause of death was not explained by postmortem
11	44	Laminectomy for arachnoiditis	Avertin local and ether	1½	1,264	+	0	Uneventful
12	16	Cervicothoracic ganglionectomy	Avertin and local	1	107	0	0	Uneventful
13	53	Section of fifth cranial nerve root for trigeminal neuralgia	Local and evipal	1	86	0	0	Uneventful
14	22	Partial removal of glioblastoma multiforme	Local	2¾	1,333	+	1	Good convalescence for 6 days Died on ninth day of epidural hematoma
15	42	Negative cerebral exploration	Local	2½	1,100	0	0	Fair convalescence Subsequently reexplored abscess drained patient died
16	51	Evacuation of cerebellar cyst	Local	2¼	1,176	+	1	Died on eighth day Autopsy did not reveal cause of death
17	14	Partial resection of ependymoma of third ventricle	Avertin and local	3½	620	0	0	Uneventful
18	31	Excision of cerebral cicatrix for epilepsy	Local and evipal	3¾	1,300	0	1	Uneventful
19	46	Partial excision of temporal lobe glioma	Avertin and local	4¼	900	0	1	Slow recovery with herniation of brain and clouded mentality
20	41	Exploration of third ventricle	Avertin and local	4	700	0	0	Uneventful
21	27	Excision of cerebral cicatrix for epilepsy	Local	3¼	1,330	0	1	Died in 40 hours probably acute perforation of esophagus or stomach No autopsy

TABLE I (*Continued*)

Patient	Age	Operation	Anesthetic	Time—Hours	Blood Loss Cc	Shock	Transfusion	Postoperative Course
22	46	Cervical cordotomy and posterior root section	Gas oxygen and local	2½	1,034	+	1	Uneventful
23	7	Cranioplasty for premature closure of sutures	Avertin and local	1¾	630	0	0	Uneventful
24	28	Suboccipital decompression for arachnoiditis	Avertin and local	3	1,010	0	1	Uneventful
25	45	Removal of large meningioma of sphenoid ridge	Local and evipal	4½	1,570	+	1	Spinal fluid leak and meningitis Died in 3 weeks
26	29	Removal of neurofibroma of lumbar cord	Avertin and local	2	860	0	0	Uneventful
27	53	Cervical cordotomy	Local and gas-oxygen	1¾	550	+	0	Uneventful
28	46	Partial removal of pituitary adenoma	Avertin local and ether	2½	1,200	0	0	Died in 8 hours
29	54	Subtotal resection of meningioma of sphenoid wing	Avertin and local	2½	2,050	0	1	Died on fourth day
30	53	Partial removal of glioblastoma multiforme	Local and ether	3	753	0	1	Period of coma due to cerebral edema followed by recovery
31	15	Negative cerebellar exploration	Local	2¾	927	0	1	Uneventful
32	16	Myoplastic craniotomy for oxycephaly	Avertin-ether and novocain	1¼	487	0	0	Uneventful
33	21	Parietal bone flap and evacuation of subdural hematoma	Avertin-ether and novocain	2	918	0	0	Uneventful
34	47	Negative cerebellar exploration	Local	2½	708	0	1	Uneventful
35	57	Total resection of meningioma of frontal lobe	Local	1¾	1,187	0	1	Uneventful
36	28	Frontoparietal exploration and biopsy	Local and ether	1¼	1,050	0	1	Transitory hemiparesis
37	53	Subtotal resection of frontoparietal astrocytoma	Local	2¼	1,289	0	0	Transitory hemiparesis with complete recovery

relatively avascular tumors, the loss of blood rose to between 600 and 1,200 cc In three patients with large meningiomata, the hemorrhage exceeded 2,000 cc * In five laminectomies the loss of blood varied from 334 to 1,263 cc A hemorrhage of over a liter in the course of an operation on the spinal cord may seem excessive, but with an epidural abscess or a vascular tumor, or in a hypertensive patient, both the muscles and the bony lamina may bleed profusely Indeed, in a patient with a hemangioma and compression of the spinal cord, the attempt to expose the tumor had to be given up after two trials on account of severe hemorrhage On the other hand, in two patients where cervicothoracic ganglionectomy and section of the fifth

* Since this article was submitted for publication one of us, W H S, has carried out additional determinations of blood loss in Dr P Bailey's clinic at the University of Chicago The results there were similar to those reported above, with a maximum of 1900 cc during the removal of a meningioma

cranial nerve root were carried out, bleeding amounted to only 107 and 86 cc, a volume comparable to that which has been reported in routine appendicectomies and herniorraphies (Table II)

TABLE II

BLOOD LOSS DURING ORDINARY SURGICAL OPERATIONS

From Statistics by Gatch and Little,[2] and Coller and Maddock[3]

Gatch and Little			Coller and Maddock		
	Operation	Amount of Blood Lost Cc		Operation	Weight of Blood Lost Gm
1	Abdominal Incisions		1	Partial gastric resection	111
A	Midline or right rectus		2	Exc thyroglossal cyst	174
1	Suspension of uterus, appendicectomy	22	3	Exploratory, kidney	208
2	Hysterectomy, appendicectomy	209	4	Repair inguinal hernia, appendicectomy	54
3	Suspension of uterus (Baldy-Webster)	28	5	Repair ventral hernia	92
4	Panhysterectomy	310	6	Exc sarcoma thigh	161
5	Appendicectomy	17	7	Exc teratoid tumor abdomen	546
6	Panhysterectomy for large fibroids	304	8	Radical mastectomy	1,272
7	Hysterectomy, appendicectomy	206	9	Partial gastric resection	274
8	Gastrectomy, Polya method, carcinoma	232	10	Colostomy	13
9	Cholecystectomy	51	11	Repair inguinal hernia	13
10	Cholecystectomy	66	12	Repair ventral hernia	147
11	Cholecystectomy	145	13	Hemorrhoidectomy	8
12	Exploratory celiotomy, appendicectomy, plastic operations on both ovaries	120	14	Repair inguinal hernia	51
13	Exploratory celiotomy	14	15	Appendicectomy	14
14	Appendicectomy, repair of abdominal wound and separation of adhesions	62	16	Cholecystectomy	55
B	Hernia		17	Appendicectomy	13
15	Left inguinal	11	18	Repair ventral hernia	306
16	Left inguinal	32			
C	McBurney				
17	Appendicectomy	4			
18	Appendicectomy	7			
19	Appendicectomy	6			
20	Appendicectomy	8			
21	Appendicectomy	7			
22	Appendicectomy	6			

TABLE II (*Continued*)

	Operation	Amount of Blood Lost Cc
2	Other Operations	
23	Thyroidectomy	504
24	Thyroidectomy, adenomata, local	16
25	Thyroidectomy, adenomata	61
26	Thyroidectomy	252
27	Radical breast amputation for cancer removal of pectoral muscles and axillary évidement	710
28	Double simple breast amputation for nonmalignant disease	400
29	Double simple breast amputation for nonmalignant disease	420
30	Drainage, acute osteomyelitis of humerus	176
31	Sequestrectomy, tibia	59
32	Sequestrectomy, tibia	40
33	Laminectomy, fracture of spine	672
34	Amputation of middle finger, metacarpophalangeal joint	44
35	Nephrectomy, left lumbar	816

It is obvious that the excessive bleeding which occurs in the usual neurosurgical operation is due to certain regional conditions which are not encountered in the ordinary procedures within the abdominal or thoracic cavities, or in the extremities In operations on the brain and spinal cord, hemostasis is rendered difficult because of the extreme vascularity of the scalp and the muscles of the back, and owing to the problem presented by the control of bleeding in the course of the elevation and closure of the bone flap or during the resection of the spinal laminae In the removal of vascular meningiomata, and other brain tumors, the problem is further complicated by the difficulty of rapidly locating and controlling the vessels in the depths of the wound In operations on the sympathetic structures and the peripheral nerves, these conditions are not encountered and the loss of blood is no greater than in other surgical procedures

Another matter of interest is the protracted reduction of the concentration of red blood corpuscles, hemoglobin, and hematocrit readings which continue progressively for from four to six days after operation These

TABLE III

HEMOCONCENTRATIONS AFTER NEUROSURGICAL OPERATIONS

	Patient 6			Patient 7			Patient 8			Patient 13			Patient 15			Patient 29			Patient 30		
Blood Loss Cc	542			599			574			86			1100			2050			753		
	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit
Preop	4 54	79	42	5 15	95	42	3 95	84	40	4 75	79	43	4 62	55	32	6 2	93	45	4 42	87	44
																Transfusion			Transfusion		
Postop	1 23	81	39	4 39	81	37	4 30	87	44	4 71	82	41	4 57	60	31	5 3	84	41			
1st day	1 01	76		3 61	72		3 64	77		4 64	73		4 11	58		5 1	82	43	3 96	75	36
2nd day	4 02	68	33	3 26	70		3 81	67	33	4 03	79	40	3 39	48		5 0	81	44			
3rd day	4 07	72		3 59	70	34	3 32	68		4 28	76		3 59	47		5 4	85	40			
4th day	3 67	63	34	3 12	74		2 99	57	29				3 19	46		Died			3 49	70	37
																			Transfusion*		
5th day	4 03	71			69					3 99	81		3 43	50	22						
6th day	3 63	69		3 36	72	30	2 94	66					3 62	52							
7th day	3 65	70	34 5	4 13	71		3 40	84	34				3 79	48					2nd Operation		
																			Transfusion*		
8th day	3 67	71												49					3 74	83	38
9th day	3 29	67		4 04	80	32							3 71	54							
10th day	3 89	72	36	3 88	85								3 59	47					4 33	101	45
																			Transfusion*		
12th day				4 13	87	34							3 77	50							

* Transfusions for low serum protein

	Patient 31			Patient 32			Patient 33			Patient 34			Patient 35			Patient 36			Patient 37		
Blood Loss Cc	927			487			918			708			1187			1050			1289		
	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit	R B C	Hb	Hematocrit
Preop	4 18	78	38	5 03	75	34	4 64	105	45	5 65	85	51	4 56	86	40	4 46	94	41	5 36	87	45
	Transfusion									Transfusion			Transfusion			Transfusion					
Postop																					
1st day	3 51	60	39	5 01	60	33	4 17	75	33	5 24	80	44	3 38	63	31	3 82	77	37	4 59	84	42
2nd day																					
3rd day	3 97	65	32	4 86	58	31				5 13		43	3 85	66	26	3 77	63	34	4 86	84	30
4th day							3 36	60	33												
5th day				5 57	66	33															
6th day																3 13	63	32	4 58	75	28
7th day	3 78	60	26				3 12	38	23	5 56	80	42	3 72	68	32						
8th day							Transfusion†														
9th day	Transfusion†																				
10th day							3 51	67								—					
12th day	4 79	80																			

† Transfusions for anemia
Transfusions contained approximately 500 cc of citrated blood
Hemoglobin measured by Sahli method

data are presented in Table III In patients whose blood changes were followed for two weeks, the erythrocyte count, hemoglobin, and hematocrit reached a minimum between the fourth and sixth days after operation These concentrations then gradually increased, returning approximately halfway back to their preoperative levels within a ten-day period Theoretically, one might expect the maximum reduction of erythrocytes, hemoglobin, and hematocrit to take place within 12 hours after operation, as the reduced number of red blood cells are diluted by tissue fluid entering the blood vessels Independent observations made by Dr John Talbott[5] at this hospital confirm our observations He interprets the continued reduction in the concentration of red corpuscles as a depression of the blood-forming elements in the body

Methods of Reducing Hemorrhage at Operation—A valuable means of controlling bleeding during craniotomies is the anesthetic A wide infiltration of the scalp with a 1 per cent novocain-epinephrine* solution diminishes bleeding Our preference is to supplement this with basal avertin, as this drug produces a moderate fall in blood pressure and thereby diminishes hemorrhage from the cerebral vessels In addition to this, basal narcosis contributes to the comfort of the patient and reduces nervousness and restlessness In patients who cannot tolerate avertin because of hypertension or poorly functioning kidneys, we have employed preliminary phenobarbital, nembutal, or paraldehyde narcosis in conjunction with a thorough regional infiltration Occasionally this must be supplemented with a very light ether anesthesia when the patient is extremely nervous or uncooperative Morphine, as is generally known, cannot be used with safety in individuals with increased intracranial pressure, because of its depressing effect on the respiratory center

Administration of the general anesthetics ether and nitrous oxide should be avoided whenever possible because they increase bleeding In the case of ether, the work of Finesinger and Cobb[6] has demonstrated that this drug, like alcohol, acts as a vasodilator on the cerebral vessels As a result, satisfactory hemostasis is not only more difficult to achieve, but the vascular network in the brain is engorged and the working space within the cranial cavity correspondingly reduced Nitrous oxide-oxygen anesthesia also produces increased bleeding because it so frequently causes partial asphyxia, and is worse than ether on account of the secondary elevation in blood pressure which goes with it When a general anesthetic must be used, a preliminary infiltration of the scalp with 0 5 per cent novocain-epinephrine solution is of value not only as a hemostatic agent, but also because a lighter level of anesthesia can be employed

While details concerning the surgical technic of hemostasis are outside the scope of this paper, it is nevertheless important to point out that the surgeon can always afford sufficient time to carry this out with the most

* For the purpose of local vasoconstriction, 0 2 cc of a 1 1,000 solution of epinephrine should be added to each 100 cc of novocain

meticulous care It should be emphasized that neurosurgical patients tolerate prolonged operations well and that in our opinion postoperative shock depends on trauma to the brain and the amount of blood shed rather than on the duration of the operation A brisk hemorrhage coming late in the resection of a brain tumor, when the vascular system has reached its limit of compensation, is serious Such a complication can never be foreseen, but much can be done to forestall its depleting effects by constant attention to hemostasis and the maintenance of a maximum reserve of blood within the vascular bed Time taken to control bleeding is never wasted

One further point concerning hemorrhage at operation should be mentioned If the neurosurgeon will measure the volume of blood lost during a series of operations, he may develop the ability to make a fairly accurate estimation by inspection of the drapes, the bucket which contains discarded gauze and cotton pledgets, and the contents of the suction bottle Assuming a hemorrhage of 1,200 to 1,500 cc as the upper limit of the average patient's ability to compensate for reduced blood volume,* it is better either to give an immediate transfusion or to postpone the total extirpation of a tumor to a second session when this point is reached

It will be seen on examining the statistics on blood loss given in Table I that these actual measurements have served to make the members of our neurosurgical operating team "hemorrhage conscious" During the three year period of this investigation every effort has been made to promote more effective hemostasis, and the improvement in the latter third of the series has been distinctly encouraging

Replacement of Blood Lost during Operation—The customary procedure on the Neurosurgical Service has been to start an intravenous infusion of 5 per cent glucose in normal saline at the beginning of every extensive operation and to permit 500 to 1,500 cc to run in slowly during the operation Citrated blood may then be substituted for the saline solution whenever there is an alarming fall in blood pressure When it is estimated that a hemorrhage of a liter or more has occurred, a transfusion is given before the patient is sent to the ward After hemorrhages exceeding 1,200 to 1,500 cc, or whenever the blood pressure remains at a critically low level, multiple transfusions are given This can be carried out on the ward if the intravenous infusion has been kept running The total fluid intake on the day of operation should rarely exceed 2,000 cc,[1] and should be given slowly over a period of five to eight hours

Discussion—From the data we have presented on blood loss during operations on the central nervous system, emphasis must be laid on certain fundamentals which differentiate this special field of surgery The outstanding feature is the increased volume of hemorrhage, which is from two to five times greater than in routine celiotomies Again, although a liter of blood is lost during the average operation for brain tumor, these patients

* Such an extensive hemorrhage can be tolerated only if it takes place gradually during a three or four hour operation

rarely go into surgical shock, unless the hemorrhage is rapid or exceeds 1,200 cc Experience with transfusion donors has taught that a healthy individual can withstand a sudden bleeding up to 500 or 600 cc While rapid hemorrhage above this amount will cause characteristic symptoms, a slow loss of twice this volume over a period of three to four hours can usually be tolerated This situation is quite different from that which is encountered in operations on the abdominal viscera Here no such extensive bleeding can be withstood because it takes place in a much shorter space of time In addition, water is lost by vaporization from the skin and lungs at a more rapid rate [1] These and other, as yet poorly understood, factors tend to produce surgical shock to a greater degree than during intracranial procedures of apparently greater severity and duration

Because sudden brisk hemorrhage may occur at any time during brain tumor resections and throw the patient into a state of uncompensated blood loss, it is of extreme importance to preserve every possible drop of blood and to be able to replace any excessive reduction in blood volume without delay The latter is accomplished by the constant intravenous administration of a 5 per cent solution of glucose in normal saline during operation, with a compatible donor waiting in an adjacent room In sudden uncompensated hemorrhage the surgeon is thereby prepared for the transfusion of citrated blood and the deficit can be restored with the minimum loss of time

SUMMARY

(1) Hemorrhage in the course of extensive intracranial operations averages from 500 to 1,500 cc This is from two to five times greater than the usual volume lost in other types of operations

(2) In spite of excessive bleeding, neurosurgical patients rarely go into shock if less than 1,200 cc of blood is lost, unless the hemorrhage is rapid, or damage is done to the centers which control circulation and respiration

(3) Hemorrhage during operation can be reduced by

(a) Meticulous hemostasis As neurosurgical patients withstand a protracted operation well, time consumed in cutting down the loss of blood is never misspent

(b) Choice of the anesthetic Ether anesthesia causes excessive bleeding secondary to dilation of the cerebral blood vessels Similarly, the administration of nitrous oxide commonly results in a rise of blood pressure and an increase in bleeding The most effective means to reduce hemorrhage is the infiltration of novocain-epinephrine solution in the scalp This may be supplemented by avertin or by one of the barbituric acid derivatives if a basal narcosis is desired

(4) Replacement of blood lost during any extensive craniotomy is best carried out by a constant intravenous infusion of 5 per cent glucose in normal saline One thousand to 1,500 cc administered in this way will take care of a gradual loss of a liter of blood After a sudden brisk hemorrhage, or failure of the organism to compensate for an excessive loss

of blood, the infusion apparatus is available for the transfusion of citrated blood

(5) Our determinations have shown that ordinarily a single transfusion of 500 cc is sufficient after a hemorrhage of from 1,200 to 1,500 cc When over this amount has been lost, or the blood pressure has failed to respond to the first transfusion in the operating room, the intravenous drip apparatus serves for a subsequent transfusion of blood on the ward

(6) The neurosurgeon should be able to make a reasonably accurate estimate of the volume of blood lost in the course of an operation Recognizing a hemorrhage of 1,500 cc as the maximum amount that can be tolerated by an average patient, it is advisable to transfuse or to postpone the total extirpation of a tumor to a second stage when this limit is approached

REFERENCES

[1] White, J C, Sweet, W H, and Hurwitt, E S Water Balance in Neurosurgical Operations ANNALS OF SURGERY, 107, March, 1938

[2] Gatch, W D, and Little, W D Amount of Blood Lost during Some of the More Common Operations J A M A, 83, 2, 1075, October 4, 1924

[3] Coller, F A, and Maddock, W G Dehydration Attendant on Surgical Operations J A M A, 99, 875, September 10, 1932

[4] Pilcher, F, Jr, and Sheard, C Measurements on the Loss of Blood during Transurethral Prostatic Resection and Other Surgical Procedures, Determined by Spectrophotometric and Photelometric Methods Proc Staff Meet Mayo Clinic, 12, 209, April 7, 1937

[5] Talbott, J H Personal communication

[6] Finesinger, J E, and Cobb, S The Cerebral Circulation The Action of Narcotic Drugs on the Pial Vessels J Pharm & Exper Therap, 53, 1, January, 1935

GIANT CELL TUMOR OF THE CERVICAL SPINE

DEFOREST P WILLARD, M D, AND JESSE THOMPSON NICHOLSON, M D
PHILADELPHIA, PA

GIANT cell tumor of the cervical spine is a comparatively rare lesion The common sites for this type of tumor, in order of frequency, are the lower end of the femur, the upper end of the tibia, the lower end of the radius and the upper end of the humerus Some difficulty is encountered in estimating its frequency of occurrence in the vertebrae because of the repetition of cases reported in the literature If this source of error can be disregarded, giant cell tumor is found in the vertebrae in 8 per cent of the cases The cervical vertebrae are reported involved in seven instances If statistics can be relied upon this represents 1 per cent of the total number of cases of giant cell tumor occurring in the vertebrae, and 15 per cent of the vertebral lesions (Table I)

TABLE I

FREQUENCY OF CERVICAL INVOLVEMENT AMONG THE REPORTED GIANT CELL TUMORS OF THE VERTEBRAE

Reporter	Year	No	Involvement of Cervical Vertebrae
Dean Lewis[1]	1924	17	1
Kolodny[2]	1928	8	?
Simmons[3]	1931	4	1
Geschickter & Copeland[4]	1935	8	0
Meyerding[5]	1936	4	1
Peirce & Lampe[6]	1936	5	0
Simmons[7]	1936	3	3
Bosworth[8]	1936	1	1
Buzby[9]	1936	1	0
Harbin[10]	1937	3	0
Osgood[11]	1937	1	1
Compere[12]	1937	1	0
		56	8

The age of the individual is, in a decided majority of all giant cell tumors, above 20, the oldest being 68 and the youngest four and one-half years In the vertebral lesions the majority are under the age of 20 The sexes are about equally represented

Giant cell tumor is classified as nonmalignant Coley, however, in reporting 50 cases, states that ten died of metastases Meyerding[5] reports but one death from metastases in 61 cases Both Simmons,[3, 7] and Kolodny[2] deny the possibility of metastasis unless the tumor changes its characteristics Geschickter and Copeland[4] recognize a "malignant variant, which is usually the result and not the cause of recurrence" This would indicate that inadequate

Submitted for publication May 26, 1937

removal or treatment is responsible for this secondary change They also claim if this "malignant variant" structure is primary, and recurrence results, metastasis is apt to follow!

Geschickter and Copeland claim that the giant cell tumor occurring in the small bones (ribs, metacarpals, metatarsals, laminae of spine, *etc*) are spindle cell variants (Giant cell tumors have a stroma of round cells with few spindle cells In the "variant" the number of spindle cells is increased) In 37 of these cases there were no recurrences except an inoperable one of the sacrum, in which a laminectomy was attempted In Dean Lewis'[1] series of 17 vertebral tumors, 13 healed after partial removal He emphasized this significant response, since ossification of the site of giant cell tumors of the long bones is extremely rare unless the tumor is completely removed or destroyed

The treatment of giant cell tumors, in general, cannot be proven by statistics Many have been subjected to combinations of radiation, curettage, cauterization, Coley's toxins, resection and amputation Simmons, Meyerding, and Geschickter and Copeland all agree that there were no deaths or recurrences following either amputation or resection

Following curettage alone, Simmons reports 19 cases with one death from hemorrhage and one recurrence Geschickter and Copeland, in 105 cases, find one death and 31 recurrences Of the recurrences, 16 were cured after a second or third curettement, seven had secondary infection with three amputations Bloodgood states that 80 per cent are cured by curettement He recommends cauterization of the base with pure phenol, then 95 per cent alcohol and finally zinc chloride Meyerding reviews ten in which he partially filled the cavity with a bone graft following the curettage None of these cases had recurrences

Radiation is usually combined with other methods of treatment There are, however, a few cases reported in which radiation alone was used Simmons states in eight cases there were six cures, one death, one amputation Geschickter and Copeland in ten cases find that five came to subsequent surgery

From these reports, if it is not too presumptuous to conclude, the treatment of choice would be curettement This failing, resection or amputation must be performed

Case Report—A white female, age 9, was brought to the Children's Hospital clinic in May, 1936, because her head tilted to one side This had been noticed six months previously No pertinent history, other than a tonsillectomy ten months before, could be obtained

Physical Examination showed the head tilted to the right 30° and rotated to the left 20° There was slight limitation of rotation to the right and lateral flexion to the left Reflexes and sensation were normal, but there was some atrophy of right arm and evidence of muscle weakness, especially loss of power in grip of right hand Upon questioning, the child admitted a sensation of "numbness of the fingers"

A roentgenogram at this time was interpreted as showing a forward dislocation of the right inferior facet of the third cervical vertebra Hyperextension failing to reduce this lesion after two weeks, a Walton manipulation was made and a plaster bandage applied to head and torso

The patient returned in July for a change of the plaster encasement Examination failed to elicit any sensory or motor disturbances There was at this time a fulness of the neck on the right side of the spinous process of the fourth cervical vertebra Roent-

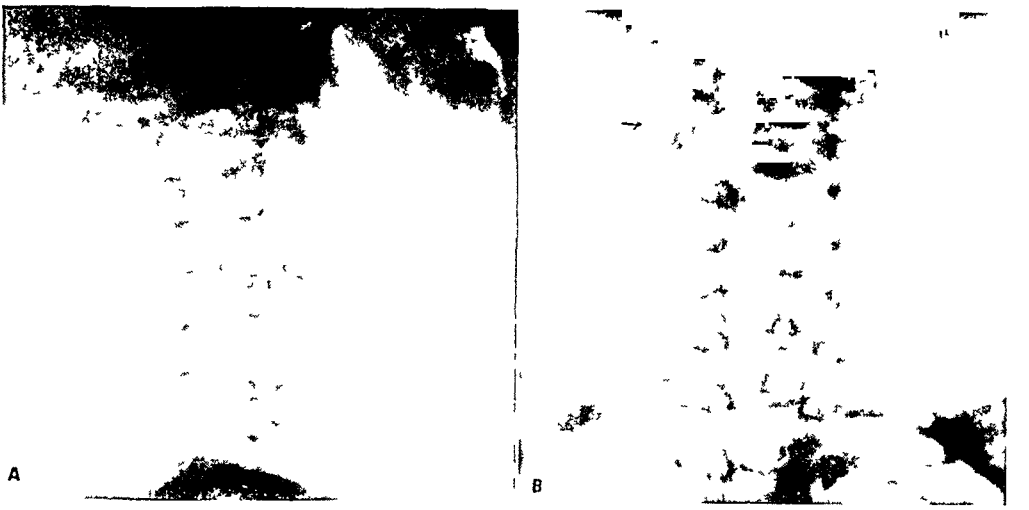


FIG 1 —(A) Roentgenogram (lateral view) showing shadow of cystic tumor mass on the right side of the fourth cervical vertebra projecting posteriorly (B) Anteroposterior view

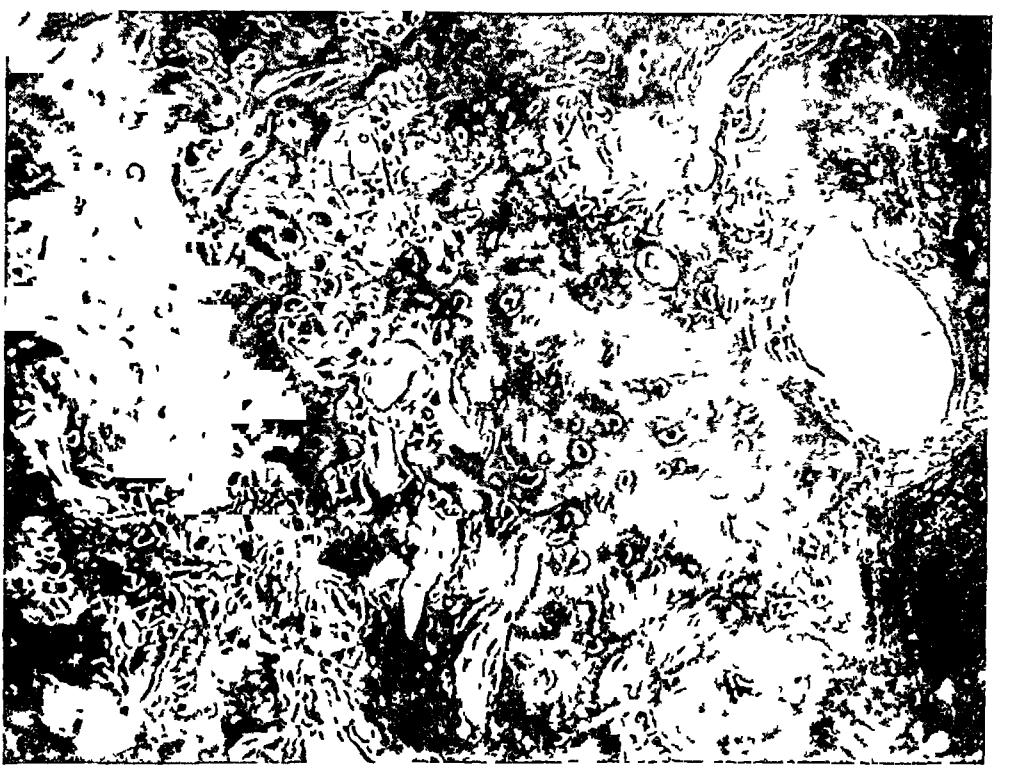


FIG 2 —Photomicrograph showing typical giant cells in a stroma of round cells containing many spindle cells

genologic examination showed a rounded cystic tumor projecting posteriorly from the fourth cervical vertebra (Fig 1, A and B) Comparison with previous roentgenograms proved it to have been present previously as a faint irregular shadow of only one-half

the diameter of the present mass Roentgenologic examination of the other bones and lungs proved negative The blood calcium and phosphorus were normal

A biopsy was performed August 14, 1936 The mass appeared well defined and localized to the fourth right cervical lamina The spinous processes and laminae on the right side of the third, fourth and fifth cervical vertebrae were removed Convalescence in a bivalved plaster encasement was uneventful

Pathologic Examination—Dr A D Waltz "Grossly the specimen consists of several pieces of bony material, the largest about 1 cm across The narrow inner portion is deep red in color, soft and friable, breaking away easily The next and widest portion is also deep red but contains some bony material The outer portion is grayish-white and hard Microscopically the inner friable portion is made up of spindle, oval or rounded cells, profusely studded with large giant cells showing many central nuclei The widest portion shows a network of bony trabeculae surrounding

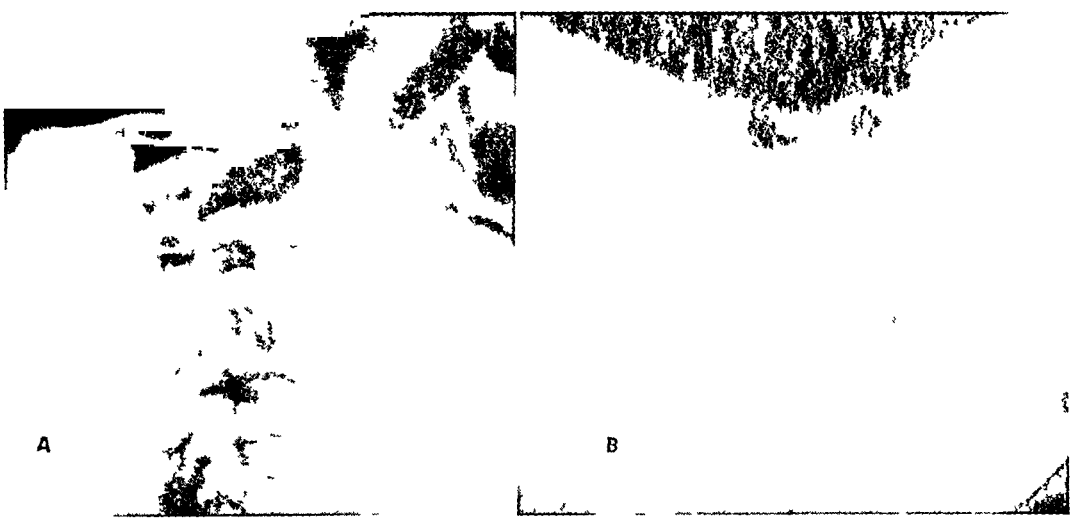


FIG 3—(A) Roentgenograms (lateral view) one year postoperative showing increase in bone density at site of laminectomy, indicating bony ankylosis but no evidence of recurrence of tumor growth (B) Anteroposterior view

larger or smaller spaces, which contain the same type of tumor and giant cell as described above External to this is osteoid tissue, which is covered by a thin shell of hard bone Giant cell tumor originating in the marrow cavity" (Fig 2)

One course of roentgenotherapy was instituted by Dr Ralph Bromer two weeks after operation This was not repeated for fear of disturbance to the thyroid and parathyroid glands

Roentgenologic examination, in April, 1937, showed ossification but no increased size in the suspicious involvement of the right pedicle and transverse process of the fourth cervical vertebra, which had not been removed at operation

September 13, 1937, the patient was symptom free Examination revealed the head tilted slightly to the left and the chin to the right of the midline Neck motion Extension, 30°, flexion, 45°, flexion to right, 25°, flexion to left, 25°, rotation to right, 35°, and rotation to left, 45° One-eighth inch atrophy of upper and lower arm No disturbance of reflexes or sensation Roentgenologic examination at this time showed no recurrence of the tumor growth but solid bony fusion bridging the site of the laminectomy (Fig 3, A and B)

SUMMARY

A case is reported of a female, age 9, who had a giant cell tumor of the lamina of the fourth cervical vertebra The tumor was almost completely re-

moved by performing a laminectomy Pathologically it resembled the spindle cell variant of giant cell tumor recognized by Geschickter and Copeland One year after operation the patient is symptom free and roentgenologic examination does not show any recurrence

BIBLIOGRAPHY

[1] Lewis, Dean J A M A, 83, 1224, October 18, 1924
[2] Kolodny, Anatole Bone Sarcoma, Chicago, 1927 Surgical Publishing Co
[3] Simmons, Channing C Malignant Changes Occurring in Benign Giant Cell Tumors of Bone Surg, Gynec, and Ostet, 53, 469, October, 1931
[4] Geschickter, Charles F, and Copeland, Murray M Tumors of Bone Amer Jour Cancer, New York, 1936
[5] Meyerding, H W Roentgen-ray Therapy of Bone Tumors Jour Bone and Joint Surg, 18, 617, July, 1936
[6] Peirce, C B, and Lampe, Isadore Giant Cell Bone Tumors J A M A, 107, 1867, December 5, 1936
[7] Simmons, Channing C Personal communication
[8] Bosworth, David W Personal communication
[9] Buzby, B Franklin Personal communication
[10] Harbin, Maxwell Report at American Academy of Orthopaedic Surgery, Cleveland, 1937
[11] Osgood, Robert B Discussion of above
[12] Compere, Edward L Operative Treatment of Low Back Lesions American Academy of Orthopaedic Surgery, Cleveland, 1937

RATIONALE OF BONE DRILLING IN DELAYED AND UNUNITED FRACTURES

PROVISO V PREWITT, M D AND E R EASTON, M D
NEW YORK, N Y

IN ELUCIDATING as comprehensive a subject as osteogenesis in fracture repair, following the drilling operation, the following aspects must be evaluated (1) Skeletal maturity (2) Effect of local environmental biophysical states upon bone production (3) Normal bone a balanced physiologic mechanism (4) Possible physiologic effects resulting from the drilling operation

Skeletal Maturity—In the phenomenon of skeletal maturity is comprehended not only the maturation of the component bones of the skeleton, but in addition, a mechanism which controls and coordinates the linear and volumetric relations of these components one to the other—acceleratory and inhibitory influences

For the growth of a bone its resident center of ossification is most essential Quite as necessary, however, for properly coordinated growth and solidity, are the pituitary and parathyroid secretions The factor of adequate local circulation is assumed in either developing bone or in the process of its repair

This mechanism presents quite a striking similarity to the heart with its associated vagosympathetic influence The heart muscle, while automatic, is at all times subject to the tonic activity of the craniobulbar outflow of nervous impulses on the one hand, and the sympathetic autonomic impulses on the other, the resultant cardiac response being the algebraic sum of the two opposing influences

In the case of a bone, its growth is intimately dependent upon its ossification center The activity of this center and the consequent development of the bone are determined by the pituitary (in close association with the craniobulbar outflow) and the parathyroid secretions (in close association with the sympathetic autonomic outflow) The ascendancy of pituitary function may result in acromegaly or gigantism, while preponderance of the parathyroid secretion may result in destruction of bone or Recklinghausen's disease

Effect of Local Environmental Biophysical States upon Bone Production—Following a previous statement that the ossification centers determine the limits of the mass of a bone subject to the secondary influences of hormones elaborated by the pituitary, parathyroid and perhaps other glands, the actual deposition of bone is a synthetic reaction occurring immediately at the site of bone production The differential importance of the various components of the bone in the process of new bone formation has been conclusively demonstrated

Conclusions from the clinical application of bone grafts are, however, open

Submitted for publication March 10, 1937

to question in the light of present facts The work of Ollier,[1] McWilliams,[2] Phemister, *et al*, confirmed the findings of Duhamel, in the mid-eighteenth century, concerning the prime importance of the periosteum in osteogenesis Based upon similar corroboration, Mock,[3] Delangeniere,[4] Albee,[5] and Haas[6] insist upon bone grafts containing periosteum

The *in vitro* studies of Dobrowolskaja[7] revealed slight bone growth from periosteum alone, steady bone growth from pieces of cortical bone alone, and luxuriant growth from spongy bone containing marrow Ollier,[1] Barth,[8] Axhausen,[9] Macewen,[10] and Groves[11] have demonstrated that a tube inserted into the medullary canal soon became filled with bone Johnson[12] showed that when the nutrient arterial supply to the bone marrow and inner one-half of the cortex is intact, it is productive of a much more rapid bone repair than is the case with the blood supply to the periosteum and outer one-half of the cortex Berg and Thalhimer[13] felt they obtained even greater growth from those transplants containing endosteum than from those including periosteum

Therefore, in the clinical application of bone grafts there is insufficient control of the components of the grafts or its recipient to permit of trustworthy conclusions The weight of evidence, however, definitely favors endosteum over periosteum as a source of osteogenesis

In a series of very well controlled experiments, McGaw and Harbin[14] attempted to determine the use of bone marrow and endosteum as a free graft to stimulate or hasten osteogenesis A small mass of marrow and endosteum removed from the tibia in dogs was substituted for a three-eighths inch resected segment of fibula in the same subject The opposite fibula was similarly resected for control They concluded that "Bone marrow and endosteum play a very active rôle in the formation of callus and new bone in dogs" There are now well controlled series of human experiments which confirm this

The experimental studies upon hyperparathyroidism show conclusively that the halisteresis, or solution of mineral salts, is a local reaction at the interphase between tissue fluids and the bone The secondary effects of narrow zones of decalcification of trabeculae, haversian canal, subperiosteal and endosteal surfaces result only from the foregoing phenomenon Conversely there is incontrovertible evidence that bone synthesis or production is a similar local surface process

The local question arises What are the causative biophysical processes underlying this mechanism of bone production? It is not sufficient to state that certain important bone constituents and adequate circulation are imperative At present all of the chemical and physical requirements are not known

Rosahn[15] recently reported the serum phosphatase content of a group of normal rabbits varying in age from 15 to 71 days He found the phosphatase values in this group to describe a significant linear decrease with increasing age and weight Such findings might logically be anticipated since all bones of the body are growing, the sum total of the local reactions being equivalent

to a general reaction, thereby increasing this enzyme in the general circulation

That bone repair is a local phenomenon has been conclusively demonstrated by Wilkins and Regan[16] In an adequately large series of perfectly controlled experiments upon rabbits, phosphatase determinations were made of the fracture foci at increasing intervals following the experimental production of comminuted fractures of both ulnae They conclude that "Following fracture of adult rabbit bone there is a rapid rise in the phosphatase activity at the site of bone injury which reaches a peak at some time near the twenty-second day and drops gradually as repair progresses" They also state that Some of the rabbits showed a slight elevation of plasma phosphatase at the time when the phosphatase activity at the site of fracture was maximum This elevation was so slight that its significance is questionable

Phosphatase determinations on the foreleg bones after removal of the fractured segment in the two 56 day animals gave figures within the normal range of the unfractured whole foreleg bones While the number of experiments is too small to permit of indisputable conclusions, it is more than suggestive that enzymic activity associated with bone repair is limited to the site of the bone injury

Since the above experimental evidence demonstrates the unquestionable presence of local phosphorus anabolism in fracture repair, it might logically by hypothecated that at least two other phenomena occur simultaneously Calcium is deposited during this process Its deposition may result from enzymic synthesis or electrolytic concentration at certain cellular or membrane interphases As yet there is no evidence to support either hypothesis

The laying down of fibroblasts and endothelial tissue for sustentacular and circulatory functions, respectively, in soft tissue, does not result in mineral deposition as in the case of osteogenesis The presence of these tissues, however, is universal in successful bone repair Wherein then does bone repair differ from ordinary soft tissue repair? As shown above, the cells of bone marrow and endosteum play a very active rôle in new bone formation It seems logical, therefore, to suppose that locally a system of fibroblasts is formed in the meshes of which the periosteal, endosteal and marrow cells are supported The rapidly growing endothelial cells develop into a sustaining circulatory network which permits of the elaboration of such enzymes by the bone cells as are necessary for the production of new bone

Normal Bone a Balanced Physiologic Mechanism—Before attempting to discuss this subject, a comparison of certain generalized destructive bone diseases such as Recklinghausen's disease, osteomalacia, Paget's disease and senile atrophy may be informative

A well advanced case of Recklinghausen's disease is characterized by Thinned cortex, porosity, bone cysts, osteoclasts with their Howship's lacunae and marrow fibrosis, grossly and microscopically Biologically there is a decrease in serum phosphorus and an increase in both the serum calcium and

phosphatase There is an associated increase in urinary excretion of calcium

Regardless of any concept of a hormonal effect by the parathyroids in the etiology of this disease, there is not only definite evidence of complete lack of osteogenetic activity by periosteum, endosteum, cortex and medullary substance, but a positive swing in the direction of osteoclasis In osteomalacia the bones show wide osteoid margins, very little marrow scarring and relatively few osteoclasts Chemically a marked reduction in serum calcium is shown, the greater portion being excreted through the bowel From these facts one might hypothecate an attempt at osteogenesis, particularly by the periosteum with a concomitant failure of mineral anabolism

Lamellation and thickening of the cortex of long tubular bones without giant cell tumors and cysts, as in Recklinghausen's disease, characterize Paget's disease The blood reveals a very high phosphatase content There is no mineral imbalance Herein is demonstrated a hyperosteogenetic function by the periosteum with commensurate mineral deposition and a concomitant increase in phosphorus enzyme

Senile osteoporosis is a process of chronic atrophy of bone In a very advanced case may be seen only cysts due to liquefaction of marrow fat, in some of the long bones This disease represents a failure of histogenesis on the part of the bone components and an inability to retain the minerals previously present

Considering the bone locally, eliminating any attempt at conjecture or hypothesis concerning the primary etiology of the above pathologic states, a dissociation between cellular activity and mineral metabolism is immediately obvious For example Contrasting Recklinghausen's disease with Paget's disease, there is not only a negative reaction by the cellular structure but active destruction There is also loss of mineral substance from the bone In Paget's disease on the other hand, there are cellular production and addition of minerals There is positive cellular reaction with loss of minerals in osteomalacia, and finally in senile osteoporosis there is little or no cellular change but marked loss of minerals

After correlating all of the above facts and hypotheses, it would seem that in growing bone the processes of cellular proliferation and mineral deposition are simultaneous, the balance being in the positive phase In certain destructive diseases of bone, as Recklinghausen's disease, there is a negative balance, while in normal bone the processes of osteogenesis and osteoclasis are in balance That the mineral salts are actively held, and not merely passively present, is evidenced by their disappearance from the head of the femur after fracture in certain cases and in senile osteoporosis This phenomenon, together with that of callus production without calcification, shows bone formation to consist of two processes, namely Cellular proliferation and mineral deposition, and, further, that since cellular proliferation always precedes calcification, the latter process is dependent upon, and results from, the former

Physiologic Effects Resulting from the Drilling Operation—Notwithstanding the fact that Beck[17] is given priority in the drilling of malunited fractures by Carter, *et al*,[18] this credit is justly due to an American surgeon

Daniel Brainard[19] was awarded first prize by the American Medical Association, in 1854, for his essay on a "New Method of Treating Ununited Fractures" In this essay are detailed reports of successfully perforated cases of ununited fractures of radius, ulna, tibia, fibula and mandible The method consisted in passing a spear shaped drill, called a "perforator," varying from two millimeters to more than one-eighth of an inch in diameter, subcutaneously through the healthy bone in each fragment, traversing the line of fracture This procedure of making multiple drill holes was repeated at intervals of from five to ten days Again, in 1858, Brainard[20] reported 13 cases of ununited fractures treated by subcutaneous perforation of the bone The technic as described by Beck,[17] Carter,[18] Bohler,[21] Bozsan[22] and others, while varying slightly in type of instruments, site of application, *etc*, remains identical in principle with the method originally introduced by Brainard, in 1854, in this country In the cases herewith presented the method was highly successful in the production or stimulation of osteogenesis

ILLUSTRATIVE CASE REPORTS

Case 1—A J, male, age 20, sustained a compound fracture of the middle third of the left tibia and a double fracture of the left fibula, resulting from a fall down an elevator shaft, in 1930 Slide graft effected in 1931 Graft absorbed In 1932, the tibia was pierced ten or 12 times with bone drill Bony union solid after three months

Case 2—A U, female, age 61, slipped on an orange peel, fracturing the neck of the left femur After reduction and the application of a plaster spica for eight weeks, no union resulted and there was a distinct slipping of the fragments Four days after reduction and retention with a Jones traction splint, the hip was drilled according to the technic of Bozsan Splint left in place for 16 weeks, then walking calipers Roentgenologic examination one year after operation showed firm bony union with some absorption of neck

Case 3—E L, female, age 54, fell in December, 1934, fracturing the surgical neck of the left humerus At an open reduction operation, February 26, 1935, the coracobrachialis and short head of the biceps were found to be interposed between the fragments The fracture was pierced eight to ten times with a drill and fixed with two Easton nails, which were removed after two months April 10, 1935, roentgenologic examination demonstrated solid bony union

Case 4—V P, female, sustained a compound fracture of the left tibia and fibula at the junction of the upper and middle thirds Union was delayed The fracture was drilled (Dr J V Bohrer) Solid bony union was present after six weeks

Case 5—F C, female, age 55, fell September 21, 1935, fracturing the right tibia and fibula at the junction of the middle and lower thirds Treated by a plaster encasement elsewhere The encasement was removed after five weeks and the patient allowed to walk Nonunion resulted Wassermann three plus The fracture was drilled December 3, 1935, and the plaster encasement was applied for six weeks, during the last three of which the patient was allowed to walk with leg still in the plaster bandage At end of six weeks solid bony union was present

Case 6—J M, male, age 17, was thrown from a motorcycle February 7, 1934, receiving compound comminuted fractures of the right tibia and fibula at junction of middle and lower thirds Nine months later, October 14, 1934, upon discharge from

hospital, there was a posterior bowing, false point of motion, exuberant callus, and no calcification was demonstrable by the roentgenograms The fracture was drilled March 2, 1935 Roentgenologic examination showed increasing bony union although a false point of motion was still present On July 16, 1935, union was firm, there was no false point of motion, and calcification was apparently present

Case 7—N C, female, age 59, fell November 7, 1935, fracturing the neck of the femur at its midportion Eleven days after reduction by the Ledbetter method and application of plaster spica, the fracture was drilled and fixed with Easton nails, because of anticipated delayed or nonunion The nails were removed 72 days later The plaster encasement was removed one month after removal of the nails, at which time there was roentgenologic evidence of early union On June 15, the patient walked without support Roentgenologic examination showed firm union at the site of fracture

Case 8—G W, male, age 54, fell down a flight of stairs fracturing both the tibia and fibula in their distal thirds The injury to soft parts was considerable Traction was maintained for one month by a Steinman pin, followed by immobilization in a plaster encasement There was no evidence of union after three months Three weeks after drilling and immobilization in a plaster bandage, union was firm

Case 9—B W, female, fell January 28, 1936, sustaining a subcapital fracture of the neck of the femur Wassermann three plus Reduction was effected by a combination of the Murray and Ledbetter methods, and a plaster spica applied The fracture was drilled and two Easton fixation nails inserted through a window in the plaster encasement two weeks after the reduction because of anticipated delayed or nonunion On June 30, the patient walked without support, and roentgenologic examination showed firm union at fracture site

Case 10—W O'S, male, age 45, was struck by a car, December 5, 1936, sustaining a complete oblique fracture of midportion of the shaft of left tibia and fibula Reduction and application of plaster incasement under general anesthesia December 21, 1936, fragments were overriding and there was no union Multiple drilling and fixation of fragments with Easton nails was effected at open reduction January 28, 1937, nails were removed, solid bony union was evident clinically and in roentgenograms December 13, 1937, result was excellent, no defective gait

Case 11—C K, female, age 78, fell on the sidewalk December 28, 1936, sustaining a subcapital fracture of neck of femur Immediate reduction by Leadbetter method and plaster spica No union resulted February 18, 1937, open reduction, multiple drilling and fixation of fragments with Westcott nail April 10, 1937, roentgenogram showed bony callus December 10, 1937, bony union solid Walks without support, gait normal

Case 12—S H, female, age 51, fell down stairs, February 9, 1937, fracturing neck of femur Reduced by Leadbetter method and applied Whitman plaster spica same dav April 3, 1937, roentgenogram showed slipping of fragments Open reduction, multiple drilling and fixation of fragments with Westcott nail April 27, 1937, roentgenogram showed callus formation December 13, 1937, solid bony union Function normal

Case 13—A R, male, age 23, struck by a car December 12, 1936, sustaining compound comminuted fracture of middle third of right tibia and fibula and simple comminuted fracture of middle third of left tibia May 12, 1937, false motion very definite in left tibia Fragments multiple drilled and plaster encasement applied Three weeks later union was firm clinically December 21, 1937, solid bony union with very satisfactory functional results

Case 14—N C, female, age 22, on September 28, 1936, in auto accident, sustained a compound fracture right radius and ulna, two inches above wrist joint and complete transection of ulnar nerve and artery Immediate debridement, open reduction, ligation of artery and repair of nerve were effected and plaster encasement applied February 12, 1937, no union Same date multiple drilling of radial fragments March 17, 1937, multiple drilling of ulnar fragments and fixation with No 28 stainless steel wire Arm immobilized in a plaster encasement Four months later solid bony union in both bones December 20,

1937, bony union solid, circulation normal, function of ulnar nerve nearly normal Patient recently played 25 games of tennis without discomfort

Delay and nonunion of fractures occur with greater frequency in certain localities than in others, for example The neck of the femur, lower third of the leg, certain carpal bones, *etc*, because of the relative paucity of blood supply The circulation to these areas is supplied by one relatively small artery with few or no anastomotic branches In other localities, malunion may result from the interposition of massive impenetrable hematomata There is evidence that the molecular dissociation of such clots inhibits the enzymic and proliferative processes so essential to new bone formation

The drilling operation is indicated where (a) One of the opposing fragments is viable (b) There is a potentially adequate arterial blood supply in one of the fragments (c) The distance between the fragments is not too great to be spanned by a reasonable amount of new bone

The passing of a proper drill through the normal bone of both fragments traversing the fracture area (a) Injures all coats of the arteries and veins, particularly the endothelial linings, (b) injures normal periosteum, bone cortex, endosteum and marrow, (c) leaves conduits which contain a soft pulpy mixture of the foregoing elements Normal adult tissue of this type, when injured, resumes its embryonic capacity to reproduce itself

Based upon all of the foregoing facts and hypotheses the production of new bone probably occurs as follows The fibroblasts ramify throughout the multiple drill holes forming a sort of arbor Perhaps the first element to permeate the connective tissue stroma, and aid in its completion, is the capillaries resulting from reproduction by the injured endothelial cells

The last and slowest growing types of cells to invade those regenerating areas are those derived from the medulla and cortex of the normal bone As the bone cells revert to the embryonal types, with capacity to reproduce, they also acquire a glandular function, in that they elaborate an enzyme or enzymes through the action by which calcium and phosphorus are taken from the blood stream and tissue fluids to be deposited within the interstices of this newly formed mass of cells

Osteogenesis and osteoclasis are the opposite extremes of a highly complex reversible biophysical reaction When the circulation is inadequate as in some cases of fractured head of the femur, the "N" point is necrosis and absorption of the proximal fragment—osteoclasis

If all constituents in this highly complex reversible osteogenetic reaction are coordinated, the "N" point is represented by normal adult calcified bone

CONCLUSIONS

The bone regeneration following the drilling operation for delayed or ununited fractures results from (1) Injury to the fracture area with the consequent enrichment of local circulation, the so-called "freshening up" process (2) Grinding and depositing within the drill canals the various bone cells, stimulating them to renewed embryonal activity to grow and reproduce

(3) Causing certain of the bone cells to elaborate calcium and phosphorus conjugating enzymes so necessary for the deposition of calcium phosphate within the mass of callus, the so-called "bony callus"

REFERENCES

[1] Ollier, L Traite Experimental et Clinique de la Regeneration des os et de la Production Artificielle du Tissu Osseux Paris, Victor Masson et Fils, 1867

[2] McWilliams, C A The Function of the Periosteum in Bone Transplantation Based on Four Human Transplantations without Periosteum, and Some Animal Experiments Surg, Gynec, and Obstet, 18, 159, 1914

[3] Mock, H E Periosteal Transplants in the Repair of Delayed Union, Ununited Fractures and Loss of Bone Substance Surg, Gynec, and Obstet, 46, 641, 1928

[4] Delangeniere, H Greffes Osteo-Periostiques Technique et Applications J de Chir, 17, 305, 1921

[5] Albee, F H The Inlay Bone Graft as a Treatment of Ununited Fractures A Report of Fifteen Successful Cases Amer Jour Surg, 28, 21, 1914

[6] Haas, S L Regeneration of Bone from Periosteum Surg, Gynec, and Obstet, 17, 164, 1913

[7] Dobrowolskaja, N A On the Regeneration of Bone in Its Relation to the Cultivation of Bone Tissue Brit Jour Surg, 4, 332, 1916

[8] Barth, Arthur Uber Histologische Befunde Nach Knochenimplantationen Arch f klin Chir, 46, 409, 1893

[9] Axhausen, George Die Jistologischen und Klinichen Gesetze der Freien Osteoplastic auf Grund von Thiewersuchen Arch f klin Chir, 88, 23, 1909

[10] Macewen, Sir William The Growth of Bone, Observations on Osteogenesis An Experimental Inquiry into the Development and Reproduction of Diaphysical Bone Glascow, James Maclehose & Sons, 1912

[11] Groves, E W Hey On Modern Methods of Treating Fractures 2nd Ed, William Wood Co, N Y, 1922

[12] Johnson, R W, Jr A Physiological Study of the Blood Supply of the Diaphysis Jour Bone and Joint Surg, 9, 153, 1927

[13] Berg, A A, and Thalhimer, William Regeneration of Bone Am Surg, 67, 331, 1918 331, 1918

[14] McGaw, W H, and Harbin, M The Role of Bone Marrow and Endosteum in Bone Regeneration Jour Bone and Joint Surg, 32, 816, 1934

[15] Rosahn, Paul D Serum Phosphatase in Normal Young Rabbits Proc Exper Biol and Med, 32, 1601, 1935

[16] Wilkins, Walter E, and Regan, Eugene M Course of Phosphatase Activity in Healing Fractured Bone Proc Exper Biol and Med, 32, 1373, 1935

[17] Beck, A Zur Bekandlung der Verzogerten Konsolidation bei Unterschenkelbruchen Zentralbl f Chir, 56, 2690, 1929

[18] Carter, Ralph M A New Treatment for Delayed Union or Non-Union in Fractures Jour Bone and Joint Surg, 16, 925, 1934

[19] Brainard, Daniel Prize Essay (American Medical Association) on a New Method of Treating Ununited Fractures and Certain Deformities of the Osseous System Baker, Goodwin and Co, New York, 1854

[20] Brainard, Daniel Report of Thirteen Cases of Ununited Fractures Treated by Subcutaneous Perforation of the Bone Chicago Med Jour, 50, 421, 1858

[21] Bohler, Lorenz Pseudoarthrosenbekandlung mit der Beck'schen Bohrung Zentralbl f Chir, 57, 1654, 1930

[22] Bozsan, E J A New Treatment of Intracapsular Fractures of the Neck of the Femur and Legg-Calve-Perthes Disease Technique Jour Bone and Joint Surg, 16, 75, 1934

BRIEF COMMUNICATIONS AND CASE REPORTS

STAB WOUND OF THE HEART TWENTY-ONE YEARS AFTER SUTURE

JOHN F X JONES, M D
PHILADELPHIA, PA

Case Report—G L P, Negro, male, age 18 at the time of operation, 21 years ago, when a stab wound in the left ventricle was sutured by the author, at St Joseph's Hospital, April 18, 1916 The patient was presented before the Philadelphia Academy of Surgery, and reported in the ANNALS OF SURGERY, 65, 120, January, 1917

The patient was discharged from St Joseph's Hospital early in June, 1916, and was not seen again until May 5, 1937, when he appeared as a very muscular individual, weighing 160 pounds Height five feet, ten inches

He is now 39 years of age He has married, and is the father of six children During the intervening 21 years he has worked at hard manual labor, frequently as a longshoreman At present he has a four plus Wassermann and a four plus Kahn reaction It is not known how long these have existed

Physical Examination—May 5, 1937 Along the left side of the thorax there is an area of softening of bone and of cartilage, extending downward along the left sternal margin from the second to the fifth rib, measuring 7 1 by 3 cm This region of diminished resistance protrudes when the patient coughs Treatment of his neglected lues may improve this condition A protective corset over this weakened area seems indicated

An electrocardiogram, May 10, 1937, by Dr R V Patterson, showed "The rate is 80 per minute, the rhythm is regular, the conduction function is normal, left ventricular hypertrophy and myocardial degeneration are definitely indicated"

Orthodiagraphic studies made by Dr John T Farrell, Jr, May 11, 1937, showed little, if any, enlargement of the heart He states "The third and fourth ribs on the left side are deformed anteriorly and there is an adhesion deforming the left half of the diaphragm Outside of these variations the intrathoracic structures are essentially normal Looking at the film, the heart appears to be a little larger than the average but with the measurements of the orthodiagram it is well within normal limits"

AN AMBULATORY TREATMENT OF FRACTURE OF THE PATELLA

EUGENE ST JACQUES, M D
MONTREAL, CANADA

IN THE ANNALS OF SURGERY, 101, 1082–1090, April, 1935, there appeared an article on "An Ambulatory Method of Treating Fractures of the Patella," by Roger Anderson of Seattle His method requires "Reduction by the application of skeletal traction to the upper patellar fragment, and immobilization through the agency of a plaster case in which are incorporated both this superior transfixion and a distal anchoring pin passed through the upper end of the

Submitted for publication November 18, 1936

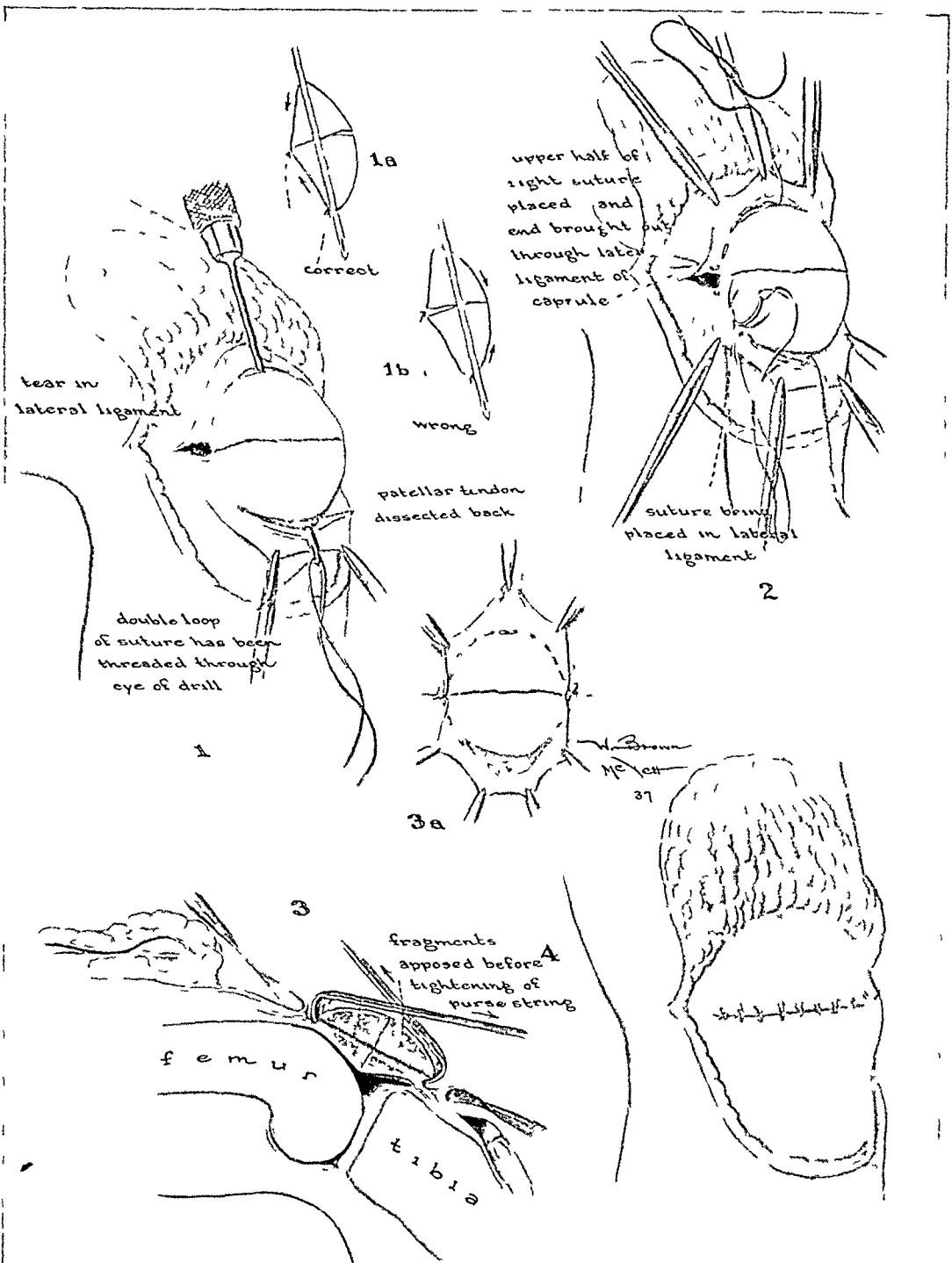


PLATE I —Drawings showing the various procedures described in the text

tibia " This technic, together with the rather cumbersome apparatus required to maintain reduction, seems unnecessarily complicated when compared with a simpler and equally efficient method in use in our clinic The latter procedure is a modification of the operation employed by Professor Delbet of Paris

A horseshoe-shaped incision is made over the patella, and the knee joint is exposed sufficiently to allow the removal of blood clots The aponeurosis of the quadriceps muscle is elevated from the anterior surface of the patella in order to expose the line of fracture adequately By means of a sharply pointed awl, vertical perforations are made through the central portions of both fragments A double strand of silkworm gut is threaded through the eye of the awl to serve as a tractor for the "metallic silk" used for fixation of the fragments This metallic suture consists of a finely twisted bronze-aluminum wire manufactured by Shearer of Bern Its caliber is about one millimeter, which is too great to allow threading it through the eye of the perforating instrument, hence the use of the silkworm-gut tractor In some cases the procedure is facilitated by perforating and drawing the suture through each fragment separately A strand of wire 45 to 50 cm in length will usually be adequate After drawing the doubled strand through the two fragments from below upwards, so that equal lengths project from each orifice, the loop formed at the upper end is cut Then, again using the silkworm-gut threaded on a heavy needle as a tractor, each of the four lengths of "metallic silk" is woven through the tendon expansion close to the lateral margins of the patellar fragments towards the line of fracture

At this point the joint is filled with Calot's fluid,* an antiseptic olive oil compound, in order to prevent the formation of adhesions and to facilitate early mobilization With the aid of a Farabeuf clamp, or other heavy clamp, an assistant then brings the fragments into anatomic alignment, while the operator draws tightly and knots the adjacent ends of wire on the medial and lateral aspects of the patella The margins of the reflected quadriceps aponeurosis are approximated with No 2 chromic catgut and the skin is closed with an intradermic suture of silkworm-gut

Immediately postoperatively, a simple wooden splint is applied posteriorly for immobilization This is worn until the fifth day when it is removed and active motion of the knee encouraged On the tenth day the patient is allowed out of bed with the splint reapplied to afford confidence On the twelfth day the splint is discarded and walking is allowed without restraining apparatus

We have employed this method with consistently excellent results for more than 20 years The rigid fixation of the fracture allows early resumption of knee motion, which in turn prevents intra-articular adhesions and the extensive atrophy which commonly follows prolonged immobilization of the knee In addition the duration of hospitalization and the duration of disability are considerably shortened

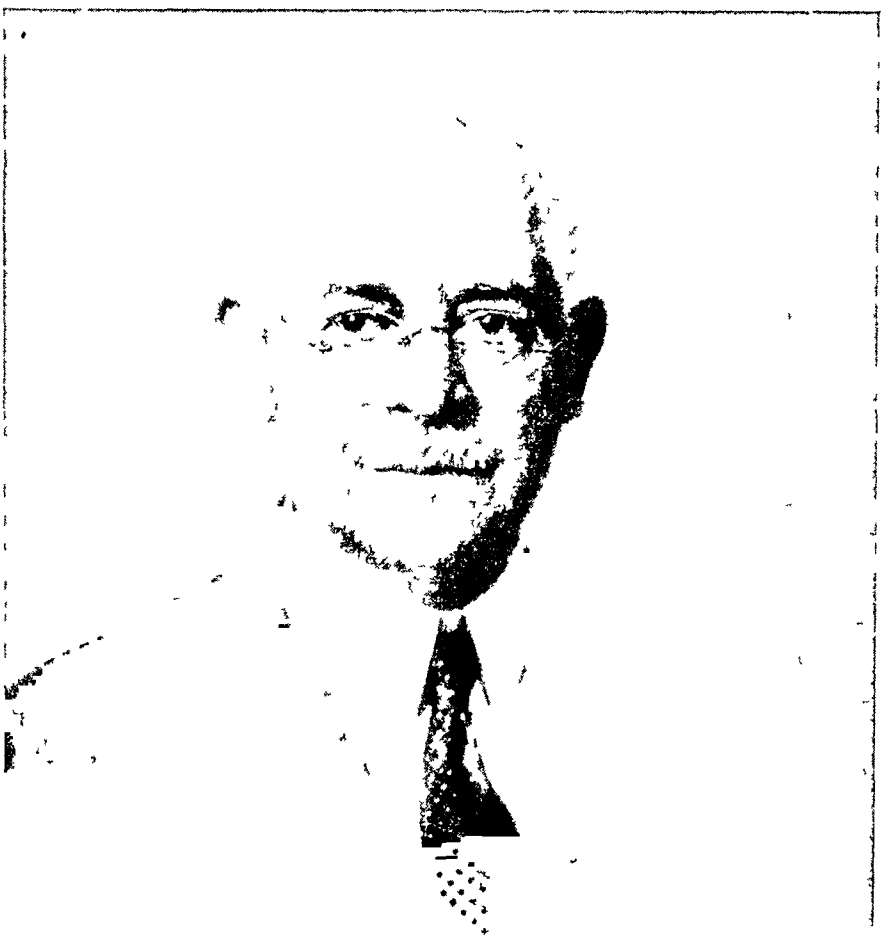
* Calot's fluid Creosote, 3 grams, iodoform, 7 grams, ether, 25 cc , olive oil (sterilized) 50 cc

MEMOIR

INGERSOLL OLMSTED

1864–1936

DR INGERSOLL OLMSTED, of Hamilton, Ontario, whose death occurred in his seventy-third year, on November 12, 1936, was one of Canada's most distinguished and respected surgeons He was born in Ancaster, and his early education was at the Collegiate Institute of Hamilton He received his M B



INGERSOLL OLMSTED M D

degree from the University of Toronto, in 1887, and following that went to Philadelphia to be an intern in the Germantown Hospital He returned to Hamilton in 1888, became resident physician in the Hamilton City Hospital and while there founded a training school for nurses Doctor Olmsted maintained such interest and activity in the fundamental fields, particularly bac-

teriology, that he was offered an assistant professorship in that field at the University of Pennsylvania in 1893 Soon after he accepted this position he used himself as the subject of an experiment, an infection developed and it was necessary to amputate his right leg below the knee On recovering from this, he resigned his position and went abroad where he studied in the clinics of Great Britain and continental Europe When he returned to America, he continued his studies at Johns Hopkins University, and again returned to Hamilton where he set up in private practice, confining his work almost entirely to general surgery Doctor Olmsted was a Fellow of the Royal College of Surgeons of Canada and of the American College of Surgeons, and he was honored in 1934 by the Hamilton Academy of Medicine with a life membership in recognition of his contributions to medical science Surviving besides his wife, Edith Olmsted, are two sons, Archie and Dr Alexander I Olmsted, both of Hamilton, and a daughter, Mrs George Hendrie

The surgical career of Doctor Olmsted, extending as it did over a period of almost 50 years, exemplifies the changing status of the general surgeon, for it is not now possible that a general surgeon can encompass with the same degree of proficiency as many fields as Doctor Olmsted, with his inquisitive mind, could master Surgeons of his day were confronted with the necessity of acquiring experience in many of the technical diagnostic fields, and since many of these were in their early stages of development, it was possible for such an energetic, studious and serious-minded worker as Doctor Olmsted, who had already had a sound training in the fundamental sciences, to learn what was known at that time in such fields For example, he was a competent roentgenologist, did his cystoscopic examinations, was one of the the earliest to use the bronchoscope, carried on his routine clinical laboratory work, and made his pathologic examinations, and on this wide knowledge of diagnostic procedures built his surgical practice It might be expected, therefore, that a surgeon with such a background would be an astute diagnostician of keen surgical judgment, and not only was this true of Doctor Olmsted, but he was also a master technician and always the true physician in the care of his patients

In his every activity, whether in the practice of his profession or in his enjoyment of the out-of-doors, particularly in golf, hunting and fishing, his inspiring enthusiasm and zealous study made him always a stimulating teacher, companion and colleague The influence of such a man and his work in a community detached from any teaching center of medicine cannot be overestimated, and he was the acknowledged leader of his profession in his part of Canada His death is a loss to the medical profession, not only of Canada but also to those who came under his tutelage, wherever they have gone

DONALD C BALFOUR

BOOK REVIEWS

POSTGRADUATE SURGERY By Rodney Maingot, F R C S (Eng), Senior Surgeon to the Royal Waterloo Hospital and to the Southbend General Hospital, later Chief Assistant to a Surgical Unit, St Bartholomew's Hospital Three volumes, 5,584 pages New York D Appleton-Century Company, Inc , 1936

"Postgraduate Surgery," edited by Rodney Maingot, attempts to cover in a practical manner the whole field of surgery In this creditable work the American reader is made acquainted with the leading surgical teachers of Great Britain, particularly of London The references are few and, as a rule, are unfamiliar to the American student Many of the technical details of operative surgery described herein are somewhat different from American surgical practice and are valuable as offering a ready means for comparison and evaluation One's enthusiasm for the work under discussion will depend largely upon what we mean by "postgraduate surgery" The editor in his preface states that "the work has been written specially for postgraduates engaged in the practice of surgery, for senior resident officers, for fellowship candidates and for medical officers of the fighting services as well as for the busy general practitioners who may be called upon to undertake urgent surgical measures and who are desirous of keeping abreast with all the modern developments in surgery" The reviewer is willing to subscribe to the first four categories, but is emphatic in his belief that this is not a work for the busy general practitioner who may be called upon to undertake urgent surgical measures

"Postgraduate Surgery" is presented in three volumes, containing 5,584 pages, and a thousand illustrations, each volume having an extensive index The material in Volume I is presented in five parts (1) Anesthesia, (2) abdomen, (3) rectum and anus, (4) roentgen ray diagnosis, (5) radium therapy Volume II is in 11 parts devoted to the head, spinal column and salivary glands, neck, breast, thorax, female genital organs, urinary system and male genital organs, sympathetic nervous system, adrenal gland, injection therapy, infections of the hand, and a section on orthopedics Volume III is a miscellaneous arrangement of 24 parts devoted to a conjurie of surgical topics, including a second section on orthopedics, cardiovascular system, plastic surgery, obstetric surgery, lymphatic system Following thereafter are hernia, deep roentgen ray therapy, venereal disease, eye, ear, nose, pharynx and throat, with a part devoted to tonsils and adenoids, tongue, esophagus, jaws, teeth, *etc*, and concluding with the thymus gland It is apparent that in a consideration of modern surgery no one mind can hope to grasp even the fundamentals of such a wide and diverse grouping of surgical topics and probably the arrangement of these parts came as the result of the extension of the editor's thought for completeness The range of material is encyclopedic and has

stimulated the reviewer to read sections wholly outside the beaten track of the restricted specialties of this country This work is in fact a series of monographs and as such presents an uneven texture of presentation Some of the contributions are outstanding and invaluable—abdomen, rectum and anus, roentgen ray diagnosis, urinary system and male genital organs, and lymphatic system With few exceptions there is an undue prolixity and too much space is consumed in mere tabulation and disjointed paragraphs which render the reading difficult to follow One senses the main impress of continental writers on English surgical thought as opposed to the contributions of American authors It comes somewhat as a shock to see the words "vomits" and "feeds," *etc*, used as substantives, together with the recommendation of remedies that are distinctly proprietary and apparently have not been passed upon by any group for new and nonofficial remedies Many "drugs" that are in daily use in Great Britain are totally unknown in the United States

The American opinion in regard to peptic ulcer is distinctly at variance with the presentation in Volume I, Chapter VI—"the treatment of chronic peptic ulcer is primarily and essentially medical" This statement without proper qualification is overly dogmatic and is not in consonance with American experience Apparently, the various contributors have had considerable difficulty in limiting the scope of their presentation Some have a minimum of description for the clinical phases of the condition under discussion but are most extensive in technical details of operative procedures Others pass over the technical part and devote most of their space to descriptive surgery One reads with considerable doubt "after the Polya types of operation, obstruction is very rare" Section 4, Chapter I "the medical treatment of gastric, duodenal and anastomotic ulcer" consists of four and one-half pages and contains some rather startling statements "If suitable treatment is given for a sufficient period, nearly every gastric ulcer eventually heals, as well as about 75 per cent of duodenal ulcers, and 50 per cent of the much more intractable anastomotic ulcers which follow gastric operations", "When the ulcer is healed the patient should begin the post-ulcer regimen which he should keep up for the rest of his life", "The suitable diet should not form clots in the stomach," yet in the next paragraph prepared chalk is given as "it has the advantage of being insoluble"

Hepatic failure is discussed under the general term "cholemia" and while "liver deaths" are mentioned, the author did not have a very clear understanding of just what is meant by this serious type of complication Section 8, on the pancreas, consists of exactly five pages with nine illustrations, eight of them being devoted to methods by which pancreatitis may be produced at operation

The reviewer searched in vain for the name of John B Murphy either in the indices or in the text on peritonitis This was particularly surprising because the modern conception of peritonitis has been developed in the last 35 years According to Sampson Handley the names of Lawson Tait, Malcolm, Treves readily come to mind and the pathologic interpretation of

peritonitis by Dudgeon and Sargent is associated with the name of John B Murphy, on the operative and therapeutic side

Orthopedics is considered in Part XVI of Volume II and continued in Part XVII of Volume III, both sections under the same authorship In Volume II, page 1,905, diverticula of the esophagus draw nine lines of description and the author provides a single illustration which shows that the "sac has been displaced and stitched in upright position" Additional information on esophageal diverticula is given in Volume III, pages 4,824 and 5,054 In spite of this the subject is very inadequately covered Disease of the thyroid gland receives but two-thirds of a page of description and the section on radical operation on the breast is very brief and without any illustrations The hormonal or endocrine treatment of chronic cystic mastitis is not mentioned In Part IX, the section on the thorax is divided into two sections, section 1 dealing with medical conditions and section 2, surgery of the thorax

Many of the operations illustrated in the section on gynecology are implemented by instruments unknown to American students One's risibilities are touched on reading on page 2,586 on "Sterility in Women" "Being American she was thoroughly up-to-date and had a 'gold' button introduced into the cervix immediately before marriage" In consonance with present day teaching the endocrine background of the menstrual cycle should merit a fuller discussion

The Injection Treatment of Hernia (Volume II, Part XIV, section 1), is in the nature of a special pleading The author's advocacy is not confirmed by the American experience in the treatment of hernia by injection Figure 1,839, page 3,254, depicting the technic of an injection into the left inguinal canal, has no place in any surgical textbook The surgeon (?) in street clothes with the ubiquitous wrist watch on his left arm, is making an injection into the left inguinal region of an undraped patient There is no visible evidence of adequate preparation of the patient or of the operator for a surgical procedure under aseptic conditions Irrespective of the merits of the injection treatment of hernia the technical procedure should be surrounded always with the same safeguards as accompany other surgical procedures

Many of the monographs in this system are excellent In fact, most of them are first class presentations of the subject For the students the work is primarily designed to serve it is to be recommended For the American surgeon of experience and competency it is valuable A knowledge of English and continental surgical thinking should prove useful in rounding out our own surgical knowledge

The publisher has produced three very ornamental volumes But, what a load to handle! Volume I weighs eight pounds, Volume II eight and one-half pounds, and Volume III nine pounds, and each one is handled with the greatest difficulty with or without the aid of a bookrest It seems a pity that each volume was not subdivided, lighter paper employed and smaller compass given to main subdivisions in order that the books could be handled easily and without fatigue In comparison with previous surgical publications from

British authors these three volumes are following the best tradition of English surgery Lucidity of expression, conservatism and a background of good surgical judgment are in keeping with the best of surgical thought The work is recommended to surgical interns, residents, and to the rising generation of surgeons There is also an additional appeal to those already in the ranks of surgery to see in its entirety a splendid pageant of modern surgery

CHARLES GORDON HEYD

THE MANAGEMENT OF FRACTURES, DISLOCATIONS, AND SPRAINS By John Albert Key, B S , M D , and H Earle Conwell, M D , F A C S Second Edit Cloth Pp 1,246 with 1,222 illustrations St Louis, C V Mosby Company, 1937

The authors have written an excellent book on the treatment of acute injuries of the bones and joints They have covered the acute phase of the subject completely and have given in detail the technic, indications, counter-indications, and dangers of the various methods of treatment

Very little space has been allotted to the chronic phase of bone and joint injuries, malunion and nonunion, the treatment of which constitutes a large part of the practice of orthopedic surgeons Although it would have been desirable to make the book complete by adequately covering this phase of the subject, the authors have admirably fulfilled their purpose, as stated in the preface, of writing a book for the student, the general practitioner, and the surgeon

ROBERT L PRESTON

BOOKS RECEIVED

THE receipt of books for review is hereby acknowledged This statement shall be regarded as sufficient acknowledgment of the courtesy of the publishers Selections will be made for review predicated upon the interests of the readers of the ANNALS OF SURGERY and as space permits

THE 1936 YEAR BOOKS OF GENERAL SURGERY, Edited by Evarts A Graham, M D, UROLOGY, Edited by John H Cunningham, M D, PEDIATRICS, Edited by Isaac A and Arthur F Abt, M D, GENERAL MEDICINE, Edited by Doctors Dick, Brown, Minot, Castle, Stroud and Eusterman, OBSTETRICS AND GYNECOLOGY, Edited by Joseph B DeLee, M D, and J P Greenhill, M D, GENERAL THERAPEUTICS, Edited by Bernard Fantus, M D, and Samuel J Nichamin, M D, EYE, EAR, NOSE AND THROAT, Edited by E V L Brown, Louis Bothman, George E Shambaugh, Elmer W Hagens and George E Shambaugh, Jr, M D, NEUROLOGY, PSYCHIATRY AND ENDOCRINOLOGY, Edited by Hans H Reese, M D, Harry A Paskind, M D, Ph D, and Elmer L Sevringhaus, M D, DERMATOLOGY AND SYPHILOGY, Edited by Fred Wise, M D, and Marion B Sulzberger, M D, RADIOLOGY, Edited by Charles A Waters, M D, Whitmer B Firor, M D, and Ira S Kaplan, B Sc, M D, Chicago The Year Book Publishers, Inc, 1936

SYNOPSIS OF GYNECOLOGY By H S, and R J Crossen, M D 2nd ed St Louis C V Mosby Co, 1937

SYNOPSIS OF DIGESTIVE DISEASES By John J Kantor, Ph D, M D St Louis C V Mosby Co, 1937

SYNOPSIS OF GENITO-URINARY DISEASES By Austin I Dodson, M D 2nd ed St Louis C V Mosby Co, 1937

TEXTBOOK OF SURGICAL NURSING By Henry S Brookes, Jr, M D St Louis C V Mosby Co, 1937

TEXTBOOK OF GENERAL SURGERY By Warren H Cole, M D, and Robert Elman, M D New York and London D Appleton-Century Co, Inc, 1936

PROCTOLOGY By Frank C Yeomans, M D New York and London D Appleton-Century Co, 1936

UROLOGY By Edward L Keyes, Ph D, F R C S (Hon London), and Russell S Ferguson, M D 6th ed New York and London D Appleton-Century Co, 1936

SURGICAL PATHOLOGY OF THE DISEASES OF THE NECK By Arthur E Hertzler, M D Philadelphia J B Lippincott Co, 1937

THE 1937 YEAR BOOK OF THE EYE, EAR, NOSE AND THROAT Edited by E V L Brown, M D, Louis Bothman, M D, George E Shambaugh, M D, Elmer W Hagens, M D, and George E Shambaugh, Jr, M D Chicago The Year Book Publishers, 1937

THE 1937 YEAR BOOK OF UROLOGY Edited by John H Cunningham, M D Chicago The Year Book Publishers, 1937

EDITORIAL ADDRESS

Original typed manuscripts and illustrations submitted to this Journal should be forwarded prepaid, at the author's risk, to the Chairman of the Editorial Board of the ANNALS OF SURGERY

Walter Estell Lee, M D

1833 Pine Street, Philadelphia, Pa

Contributions in a foreign language when accepted will be translated and published in English

Exchanges and Books for Review should be sent to James T Pilcher M D, Managing Editor, 121 Gates Avenue, Brooklyn, N Y

Subscriptions, advertising and all business communications should be addressed

ANNALS OF SURGERY

227 South Sixth Street, Philadelphia, Pa

WHY ZONITE IS SPECIFIED BY HOSPITALS, PHYSICIANS AND DENTISTS

ZONITE, prepared by electrolysis, is a mildly alkaline, patented stabilized solution containing 1% sodium hypochlorite (twice the concentration of Dakin's solution) with 10% sodium chloride

ZONITE, even when highly diluted, is a powerful germicide and fungicide Diluted with an equal volume of water, Zonite makes an improved Dakin's solution *for instant use—no waiting or testing necessary*

ZONITE is a powerful deodorant It is non-toxic and may be used for internal administration

ZONITE makes an improved Dakin's solution at equivalent chlorine concentrations as shown by cell tissue tests It is non-irritating as shown by tests on the ear of the rabbit

ZONITE has the power of dissolving necrotic tissue and pus cells

ZONITE establishes normal cicatrization of wounds in accordance with the formula of Du Nouy

ZONITE DILUTED WITH AN EQUAL VOLUME OF WATER MAKES AN IMPROVED DAKIN'S SOLUTION FOR INSTANT USE—NO WAITING OR TESTING NECESSARY

Avoid chemically prepared solutions which are not accurately standardized and which deteriorate rapidly

Avoid substitutes made from organic chlorine compounds which have no solvent action on necrotic tissue and pus cells

Save Time! Don't Take Chances!

SPECIFY ZONITE,—THERE IS A GREAT DIFFERENCE!

ZONITE PRODUCTS CORPORATION
24 New Brunswick, N J

Dr

☐ Please send me complimentary bottle of Zonite

☐ I am also interested in special prices to the profession

Street

City State

NOTE When you send in this coupon, please sign personally and clip to your professional letterhead This request is made in order to prevent unauthorized persons from obtaining samples

This book discusses what NOT *to do!*

THIS book discusses how to avoid complications and technical errors, and how to act when face to face with some of the abnormal circumstances which constantly present themselves during the course of a surgical operation It is a new and different type of surgery, conceived and projected from the vast experiences of the author and his associates It is well constructed, easily readable, rich in illustrations and case histories

This work shows not only errors and safeguards in connection with surgical operations in general, and pre- and postoperative care of the patient, but covers failures in surgery, the 'bad risk patient and the errors and safeguards in blood transfusions, operations on the head, neck, thorax, abdomen, in genera, stomach, intestinal operations, liver, biliary system, pancreas and spleen, hernia, urinary tract, male genitalia, gynecologic operations, extremities, spinal cord, and failures due to defective instruments and foreign bodies left within the body *No surgeon can afford to be without a copy* 696 pages 668 illustrations Price $10 00 (Slightly higher in Canada)

ARTHUR DEAN BEVAN, M.D. *says in his Foreword:*

"This splendid work of Dr Thorek on 'Surgical Errors and Safeguards' should be a welcome addition to the library of every progressive surgeon and advanced medical student"

SURGICAL ERRORS AND SAFEGUARDS

BY MAX THOREK, M.D.

Professor Clinical Surgery, Cook County Graduate School of Medicine Foreword by Arthur Dean Bevan, M D, *Professor and Head of the Department of Surgery, Rush Medical College of the University of Chicago*

J. B. LIPPINCOTT COMPANY

East Washington Square **Philadelphia**

Confederation Building **Montreal, Canada**

CONTRAST MEDIA VARY IN EFFECTIVENESS AS STARS VARY IN BRILLIANCE



LIPIODOL (LAFAY)* FOR PRECISE SHARP RADIOGRAPHS

These, briefly, are the eight essential features of Lipiodol (Lafay)

1 The original French iodized oil
2 Not a chloro iodized oil—contains no chlorine
3 Light amber color—helps detect deterioration
4 Bland and well tolerated even by delicate tissues
5 Relatively non irritating and non toxic
6 Precise clear cut, sharply outlined radiographs
7 Facilitates diagnosis of many obscure conditions
8 Reveals pathologic conditions which ordinary radiographs cannot visualize

Iodized Poppy-Seed Oil 40%

LIPIODOL (LAFAY)

Important Recent Publications

MODERN UROLOGY

Edited by HUGH CABOT, M D, LL D, C M G, F A C S

Professor of Surgery, The Mayo Foundation, Graduate School of the University of Minnesota, and Consulting Surgeon to the Mayo Clinic, Rochester, Minnesota

Third edition Two octavo volumes totaling 1813 pages, illustrated with 920 engravings and 21 plates Cloth, $20 00, net

Since the last edition of this encyclopedic work appeared there have been great advances in technique and radical changes in conception The revision of the text has been correspondingly radical So extensively has it been rewritten that it is practically a new work The contributors present the widest possible representation of urologic opinion in America They include the leading diagnosticians, therapeutists, surgeons and pathologists in this field—men whose reputations are based on their accomplishments and whose opinions and conclusions may be accepted without question The illustrations are profuse and, for the most part original and portray the various operative steps In its present form this text is a comprehensive, scholarly and authoritative study It is thoroughly modern in its spirit and material but soundly conservative in its principles and practice

THE NORMAL ENCEPHALOGRAM

By LEO M DAVIDOFF, M D

Assistant Professor of Neurology in the College of Physicians and Surgeons Columbia University, Attending Neurological Surgeon to the Neurological Institute of New York, New York City

and CORNELIUS G DYKE, M D

Assistant Professor of Radiology in the College of Physicians and Surgeons, Columbia University, Assistant Director of the Department of Radiology of the Neurological Institute of New York, New York City

Octavo, 224 pages, illustrated with 149 engravings Cloth, $5 50, net

This book has been written to meet the needs of general practitioners and specialists Neurological surgeons, neurologists, roentgenologists, pediatricians and internists as well as general practitioners are all called upon to diagnose these conditions and must be familiar with the normal encephalogram in order to make correct interpretations of the roentgenograms This book supplies such knowledge It offers a description of the technique, the indications and contra-indications for the performance of the test and the reactions of the patient during and after the procedure *The book constitutes an encephalographic anatomy* It provides an important fundamental aid to diagnosis and details the factors on which the correct interpretation of the encephalogram depends

NEUROLOGICAL SURGERY

By LOYAL DAVIS, M S., M D, F A C S, Ph D, D Sc (Hon)

Professor of Surgery and Chairman of the Division of Surgery, Northwestern University Medical School, Chicago, Illinois

Octavo, 429 pages, illustrated with 172 engravings and 2 plates Cloth, $6 00, net

This important new publication has been written for the general practitioner even more than for the neurological surgeon Its primary purpose is to give in clear and precise language, the facts that will add to the knowledge of the possibilities of surgical treatment in neurological disease The recent advances in this field have been so rapid that not every physician is familiar with what can be accomplished and many accept the attitude that such diseases cannot be successfully treated This work demonstrates the effectiveness of neurosurgery in the light of recent knowledge It covers injuries, tumors and abscesses of the cranio-cerebral and intracranial regions and the spinal cord, injuries of the peripheral nerves, surgical lesions of the cranial nerves, osteomyelitis, cysts, primary and metastatic tumors of the skull, the surgery of the autonomic nervous system and surgical treatment of epileptiform seizures It is an authoritative source of information that will be as welcome as it is needed

LEA & FEBIGER

WASHINGTON SQUARE
PHILADELPHIA, PA

Please send me books checked

☐ Cabot's Modern Urology (2 Vols) $20 00 ‖ ☐ Davis' Neurological Surgery $6 00
☐ Davidoff & Dyke's The Normal Encephalogram 5 50 ‖ ☐ Catalogue

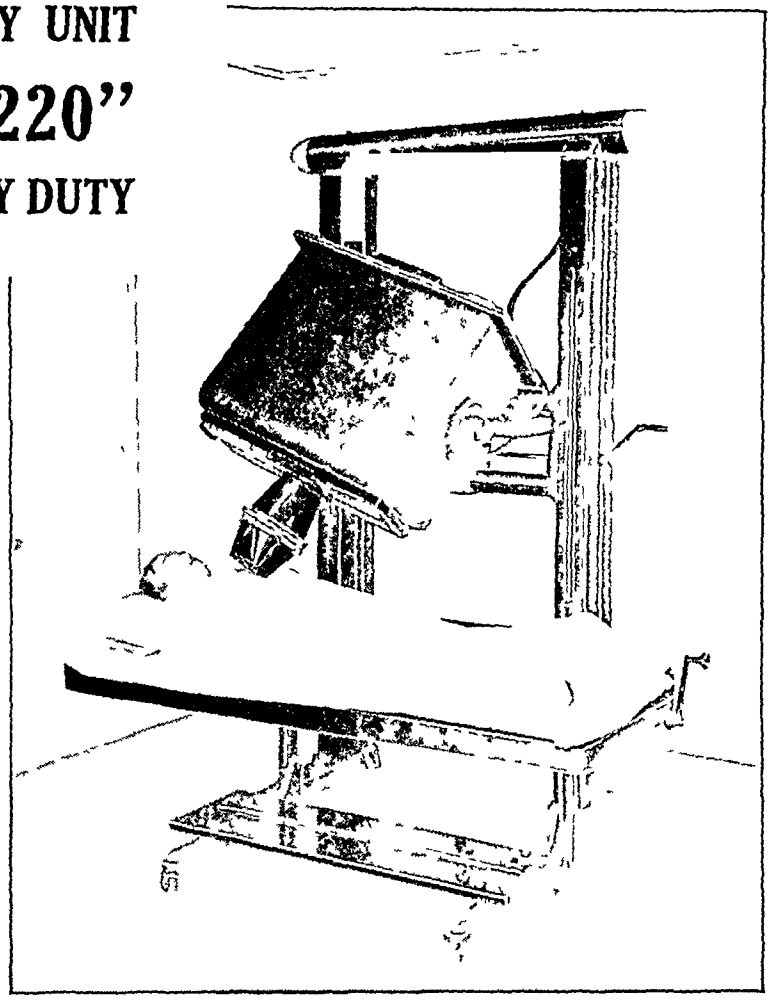
Name Address
(A of S 2 38)
20

Please mention ANNALS OF SURGERY when writing advertisers

A NEW G-E THERAPY UNIT

MAXIMAR "220"

DESIGNED FOR HEAVY DUTY



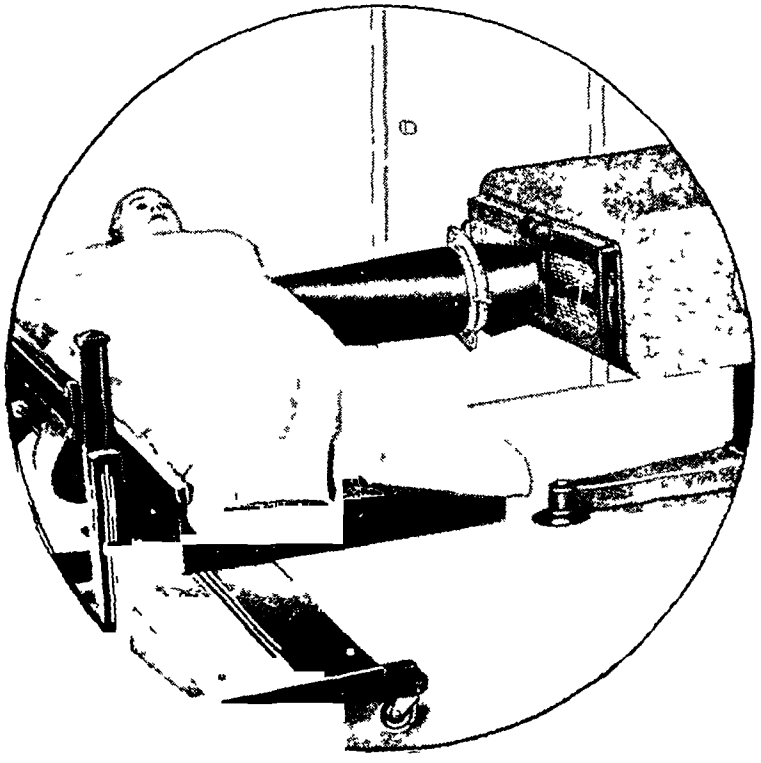
High X-Ray Output—operating at 15 ma, it is equal to that of the bulky, less flexible, 200 kv equipment of yesterday, operating at 25 ma

For all-day operation—continuous at full ratings if desired Constant circulation of oil through the tube anode and transformer tank makes this possible

Low Inherent Filtration permits use of special filters to increase intensity at the higher voltages

Ideal for intermediate therapy, too, with high intensity of long-wave radiations at the lower voltages

Unusually flexible in application, because the tube head can be adjusted vertically, also rotated about its horizontal and vertical axes, to direct the radiation most advantageously to the treatment area



● Here's a *moderately priced,* 220 kv unit with the capacity and range for a larger volume of work With it you can treat more patients per day, more economically, and operate on a convenient schedule It's the logical unit with which to meet the increasing demands on your treatment facilities

Completely oil-immersed, shockproof, dustproof, moisture proof, impervious to climatic changes, space-saving, simplified controls, reliable performance and economical operation—are more reasons why this most recent addition to the well-known "Maximar" series has a definite role in the busier laboratory

Without obligation, write for complete information —Pub. B22

GENERAL ELECTRIC X-RAY CORPORATION

2012 Jackson Blvd Chicago, Ill, U.S A



Enjoy the Comfort and Prestige of

PHILADELPHIA'S FOREMOST HOTEL

Treat yourself to the best when you visit Philadelphia stop at the Benjamin Franklin Big, comfortable rooms with every modern comfort Enjoy food that's an epic for epicures Save time and annoyance through the Benjamin Franklin's convenient location Yet all this costs you no more than ordinary hotel comfort and service



The
BENJAMIN FRANKLIN

PHILADELPHIA'S FOREMOST HOTEL

Samuel Earley · MANAGING DIRECTOR



They arrive *anorectic*



They depart *boulimic*

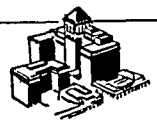
Patients who have lost appetite are apt to be down in their spirits too But they'll regain both rapidly here beside the sea The combination of exhilarating salt air and Chalfonte-Haddon Hall food works a quick change

We employ two trained dietitians They will supervise any special regimen you've prescribed, yet provide a varied menu

LEEDS AND LIPPINCOTT COMPANY

CHALFONTE-HADDON HALL

ATLANTIC CITY



Please mention ANNALS OF SURGERY when writing advertisers



Blind Man's Buff Is No Fun in Medicine

Blind man's buff is a great game for children—groping about blindfolded, stumbling over things in search of the objective

But in medicine only certainty and knowledge can lead to successful result That is why physicians of experience have definitely decided upon Agarol in the relief of acute constipation and in the treatment of habitual constipation They have found by enlightening experience that Agarol accomplishes well indeed the therapeutic objectives of intestinal lubrication, softening of the fecal contents, and stimulation of peristalsis. And Agarol does it without exacting penalties by accessory or after-effects There is not even the after-taste of artificial flavoring to get used to



AGAROL is available in 6, 10 and 16 ounce bottles Average adult dose is one tablespoonful

• *Let a brief folder explain and a liberal trial supply demonstrate to you why Agarol is preferred by physicians and their patients There are good reasons for it Please write on your letterhead*

WILLIAM R WARNER & COMPANY, INC , 113 West 18th Street, New York City

The Journal of Bone and Joint Surgery

The Official Publication of the

American Orthopaedic Association

British Orthopaedic Association

American Academy of Orthopaedic Surgeons

Owned and published by the American Orthopaedic Association

Published Quarterly:

January, April, July, and October

The only publication in English dealing exclusively with bone and joint conditions

Through the cooperation of its Foreign Editors, its pages include contributions from recognized leaders in this specialty from foreign countries as well as from the United States and Canada

In the choice of papers for publication emphasis is laid on the practical and clinical subjects

A journal of value to general surgeons as well as to those dealing with the problems of orthopaedic and traumatic surgery

Editor, E. G. BRACKETT, M.D.

8 THE FENWAY, BOSTON, MASSACHUSETTS, U. S. A.

ORDER BLANK

THE JOURNAL OF BONE AND JOINT SURGERY
8 The Fenway, Boston, Massachusetts

Please enter my subscription to THE JOURNAL OF BONE AND JOINT SURGERY for one year beginning with the issue for

☐ Enclosed find $——— in payment ☐ Will remit on receipt of bill

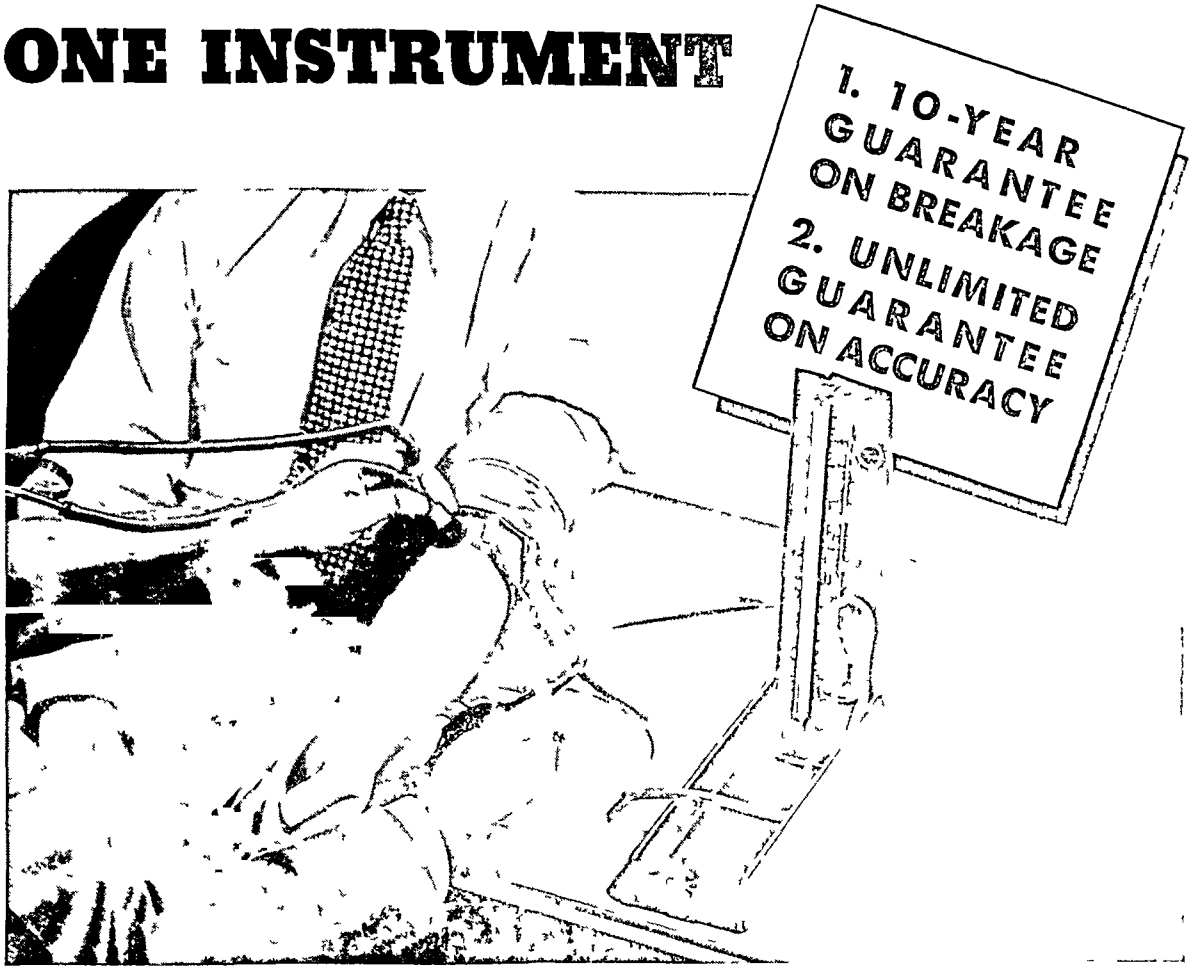
NAME STREET

CITY STATE

Subscription Price—Payable in Advance—$5.00 in the United States, $5.25 in Canada $5.75 in Foreign Countries

Please mention ANNALS OF SURGERY when writing advertisers

TWO GUARANTEES— ONE INSTRUMENT





THE CERTIFIED TYCOS ANEROID is still the outstanding instrument of its type Its portability, convenience in use and accuracy in any position make it the favorite of thousands of doctors A 10 Year Triple Guarantee covers its accuracy in normal use assures you that it will tell you instantly if ever thrown out of adjustment and that if it is ever thrown out of adjustment, correction will be made without charge On a trade in under the Tycos Exchange Plan your old sphygmomanometer gives you a $5 allowance towards a new Tycos Aneroid Price complete $25 00

Choose a Tycos Mercurial for long, dependable service

HERE is the only mercurial sphygmomanometer which has a case guaranteed against breakage The same 10-year guarantee also covers breakage or mechanical failure of any part except the inflation system And for this instrument's accuracy there is no time limit on the guarantee

What better buy can you find anywhere? You have a fine-looking instrument for your desk that is also light and compact enough to be easily portable The Tycos Mercurial is also amazingly durable Tests have proved that the glass tube is practically unbreakable Every part of the instrument is designed and built to give you long dependable service

The Tycos Mercurial is priced at $27 50 complete Take advantage of the Tycos Exchange Plan Turn in your old instrument (any age, any make), and receive a $5 00 trade-in value towards the purchase price of a new Tycos Mercurial See your surgical supply dealer for full details Taylor Instrument Companies, Rochester, N Y Also Toronto, Canada

CERTIFIED *Tycos* INSTRUMENTS

—with 10-Year Guarantee

"REQUIRED READING"

Your Personal Guide to a More Successful Practice

Dr George D Wolf is a highly successful physician who decided it was high time that someone put out a book that showed the doctor how to put his profession on a more profitable basis The result is one of the most important books any doctor can have—a book that answers and clarifies hundreds of questions and problems regarding business ethics and economics constantly confronting the busy doctor

The volume should be carefully read by the physician s secretary or office nurse as well, as much of the information and suggestions tendered in it can be applied and put into service without any instruction from the doctor whatsoever There is also a particularly useful section devoted to material teaching nurses how to give instructions to patients for home self treatment Nothing has been omitted It is all there for you—from How to make a Radio Talk to How to Give Expert Court Testimony Every doctor will find a single reading worth many times the book s cost to him Price only $5 00

DO YOU KNOW

How to go about collecting money from patients who fail to pay?
How to make your office secretary or nurse do many of the things you now must do yourself?
How to equip and plan your office to make it most efficient?
How to pick a profitable location and lay out your office?
How to avoid lawsuits?
How to keep records for your income tax?

THE PHYSICIAN'S BUSINESS

by

GEORGE D. WOLF, M.D.

Attending Otolaryngologist, Sydenham Hospital, New York City, Attending Laryngologist, Riverside Hospital, New York City, Fellow, New York Academy of Medicine, Fellow, American Medical Association, etc

Ready Soon!

"There is no finer book on the subject"

Dr Bacon s new book is comprehensive, practical and authoritative It offers an unbiased, informative description of the diversified conditions included in proctologic practice, and covers every phase of the subject It emphasizes the application of the procedure to the patient—not the patient to the procedure *487 illustrations (mostly originals) crisply picture the author's wide clinical and surgical experience*

Dr Bacon s text stresses the underlying pathology of the Anus, Rectum and Sigmoid Colon as basic to treatment He describes the various methods of examinations Diseases are detailed, giving Definition, Etiology, Symptoms, Diagnosis, Medical and/or Surgical Treatment Particular attention is given to Hemorrhoids and to Tumors, including infectious, benign and malignant tumors of the sigmoid and rectum A comprehensive, selected bibliography completes each chapter 600 pages 487 illustrations

ANUS, RECTUM AND SIGMOID COLON

Diagnosis and Treatment

by

HARRY E. BACON, M.D.

F A C S, F A P S, Assistant Professor of Proctology, Temple University School of Medicine, Associate in Proctology, Graduate School of Medicine, University of Pennsylvania

Foreword by

J P LOCKHART-MUMMERY, M A, M B, B Ch (Cantab), F R C S (Eng), Emeritus Surgeon, St Mark's Hospital, London, England

Published by

J. B. LIPPINCOTT COMPANY

Washington Square Philadelphia

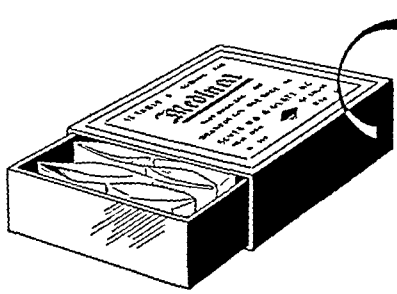


Voltaire was right

The insomniac will nod with ready assent to the philosophy of Voltaire that sleep should be placed on the same level as hope, since both of these elements contribute to a happy well-balanced life

To those who are denied the benefits of restful sleep, MEDINAL (soluble barbital) may bring restorative relief A dose of five grains generally provides eight hours of dreamless sleep Medinal tablets and powder may both be used orally, hypodermically, or by rectum Elixir Medinal is available for those who prefer palatable liquid medication.

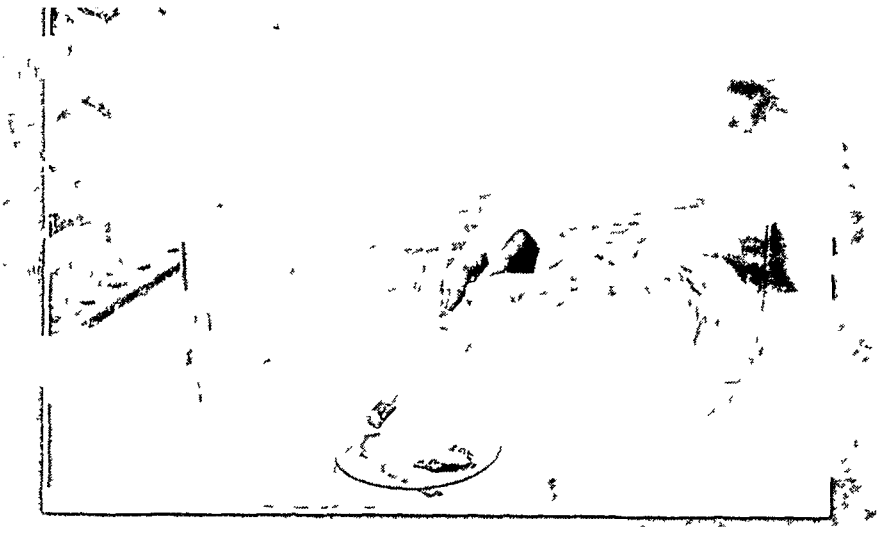
Medinal tablets are supplied in boxes of 12, and in bottles of 50, 100 and 500 Medinal powder, ½- and 1-ounce bottles Elixir Medinal in 6-ounce and gallon sizes *For a trial supply of the tablets or elixir, please write on your letterhead*



Medinal

SCHERING & GLATZ, Inc • 113 West 18th Street • New York City

Please mention ANNALS OF SURGERY when writing advertisers



Stability

A water-soluble vaginal jelly must possess the property of stability, or resistance to decomposition The standard for stability of Ortho-Gynol is high The achievement and maintenance of a high stability factor requires the finest of materials and equipment and constant laboratory surveillance

A PRODUCT OF JOHNSON & JOHNSON

© 1938 JOHNSON & JOHNSON

ortho

VOL 107 MARCH, 1938 NO 3

ANNALS of SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

Also the Official Publication of the American Surgical Association, the Southern Surgical Association, Philadelphia Academy of Surgery, and New York Surgical Society

EDITORIAL BOARD

WALTER E LEE, M D
Chairman, *Philadelphia*

BARNEY BROOKS, M D
Nashville, Tenn

E D CHURCHILL, M D
Boston, Mass

EVARTS A GRAHAM, M D
St Louis, Mo

ROSCOE R GRAHAM, M D
Toronto, Canada

SAMUEL C HARVEY, M D
New Haven, Conn

ROY D McCLURE, M D
Detroit, Mich

GEORGE P MULLER, M D
Philadelphia

H C NAFFZIGER, M D
San Francisco, Cal

D B PHEMISTER, M D
Chicago, Ill

W F RIENHOFF, JR, M D
Baltimore, Md

A O WHIPPLE, M D
New York

JAMES TAFT PILCHER, M D, Managing Editor

J B LIPPINCOTT COMPANY, *Publishers*

PHILADELPHIA MONTREAL LONDON NEW YORK

Entered at the Post Office at Philadelphia and admitted for transmission through the mails at second class rates Price $10 00 a year Copyright 1938, by J B Lippincott Company 227–231 South Sixth Street Printed in U S A

CONTENTS

Vol 107 MARCH, 1938 No 3

ACUTE ILEUS — Frederick T vanBeuren, Jr , M D; Beverly C Smith, M D — New York N Y 321

ACUTE INTESTINAL OBSTRUCTION — T Todyo, M D — Kogoshima Japan 340

PERFORATED GASTRIC AND DUODENAL ULCER — John A McCreery, M D. — New York, N Y 350

MESENTERIC LYMPHADENITIS AND THE ACUTE ABDOMEN — William E Adams, M D; Mary B Olney, M D — Chicago Ill 359

THE PATHOGENESIS OF NECROSIS OF THE CEREBRAL GRAY MATTER FOLLOWING NITROUS OXIDE ANESTHESIA — Cyril B Courville, M D — Los Angeles, Calif 371

GENERALIZED LYMPHOGRANULOMA INGUINALE — Theodore P Eberhard, M D — New York N Y 380

PILONIDAL SINUS — Matthew McKirdie, M D — Iowa City Iowa 389

PILONIDAL SINUS — Horatio Rogers, M D; Richard W Dwight, M D — Boston Mass 400

TREATMENT OF FRACTURES OF THE SHAFT OF THE FEMUR — Robert H Kennedy, M D — New York N Y 419

WATER BALANCE IN NEUROSURGICAL PATIENTS — J C White, M D; W H Sweet, M D; E S Hurwitt, M D — Boston Mass 438

(Contents continued on page 4)



Tested as Exactingly as Biologicals

. . . For Saftiflasks are produced in a government-licensed biological laboratory

UNLIKE biologicals, dextrose solutions are *not* government-licensed But isn't it logical for a laboratory with over *forty years* experience in the production of *biologicals* to use the same exacting care in the production and testing of Saftiflasks?

Biological workers know that *no* product—licensed or not—is safe for intravenous injection until it has been *proven* safe

Here, dextrose solutions in *Saftiflasks* are meticulously tested and retested—chemically, biologically, physiologically—by technicians of the same calibre demanded in government-licensed biological laboratories This group is wholly divorced from the product's *manufacture Prescribe* dextrose and other solutions *in Saftiflasks*

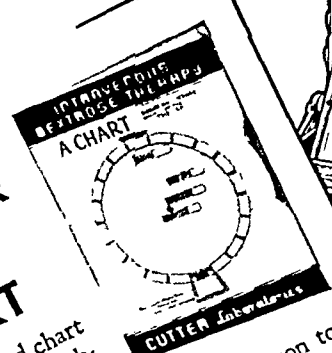
CUTTER LABORATORIES

Berkeley, Calif 111 No Canal St , Chicago

(U S Gov't License No 8)

ACCEPTED AMERICAN MEDICAL ASSN Council on Pharmacy and Chemistry





SEND FOR FREE CHART

Annotated chart and complete bibliography on intravenous dextrose therapy Gives instructions, solution to use, initial dosage, rate of injection total dosage and other information based on average (middle of the road) therapy

Saftiflasks

CONTENTS—*Continued*

SURGICAL KNOTS — Frederic W Taylor, M D, Indianapolis, Ind — 458

BRIEF COMMUNICATIONS AND CASE REPORTS

INTRAPERITONEAL STREPTOCOCCIC ABSCESS COMPLICATING ACUTE PHARYNGITIS — Arthur S W Touroff, M D, New York N Y — 469

RUPTURE OF INTESTINE INTO ABDOMINAL SCAR — Sigmund Mage, M D, New York N Y — 472

SPONTANEOUS RUPTURE OF THE LIVER IN MALARIA — John S McEwan, M D; Duncan McEwan, M D, Orlando Fla — 473

INJURY OF THE LIVER — Charles D Branch, M D, Boston Mass — 475

MEMOIR

DUNCAN EVE — William D Haggard, M D — 478

do you treat
CANCER?

THE RADIUM EMANATION CORPORATION

MAINTAINS the most efficiently organized Radium laboratory to make available to you, at low cost, every facility for the use of Radium in your practice

RADON SEEDS Removable or permanent We provide seeds of the composite type, with Radon under leak-proof glass seal Filtration 0 3 mm of Platinum

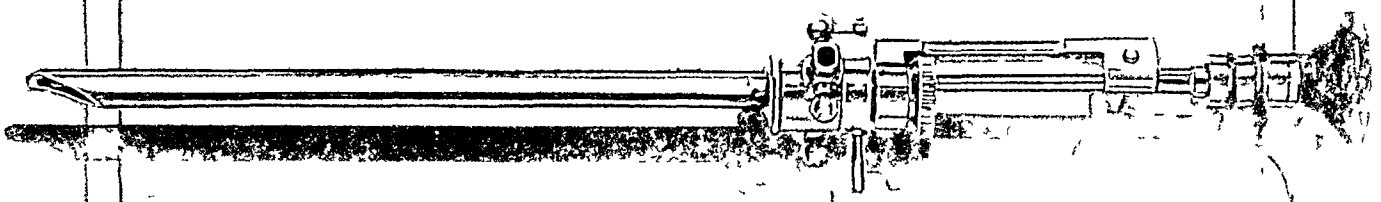
APPLICATORS Uterine tubes, cervical applicators, surface plaques properly prepared to meet the requirements of each individual case

OUR SERVICE is available to you day and night including Sundays and holidays Your inquiries and orders will receive our prompt and careful attention

THE RADIUM EMANATION CORPORATION

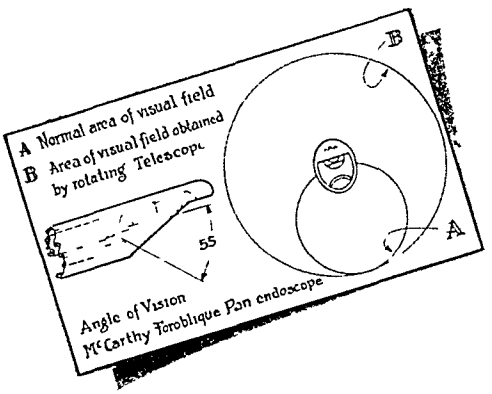
GRAYBAR BLDG **Tel MOhawk 4-6455** **NEW YORK, N Y**

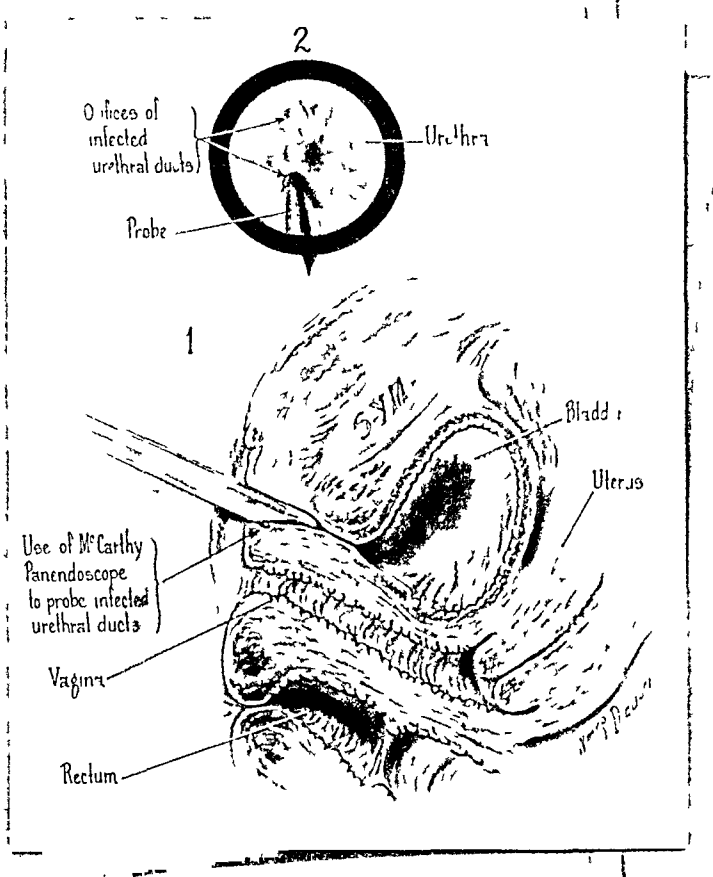
McCarthy Foroblique Pan-endoscope



This appropriately named cystoscope possesses such broad utility that it has become one of the most widely used instruments in urology

Essentially the armamentarium consists of straight sheaths a foroblique telescope and a bridge assembly for relating these elements Sheaths are available in sizes 16 to 30 Fr. The telescope is the well-known McCarthy Foroblique system noted for its natural, "amphitheatre', visual characteristics





The wide range of usefulness of the McCarthy Panendoscope is demonstrated by its ability to maintain good vision even to the female urinary meatus

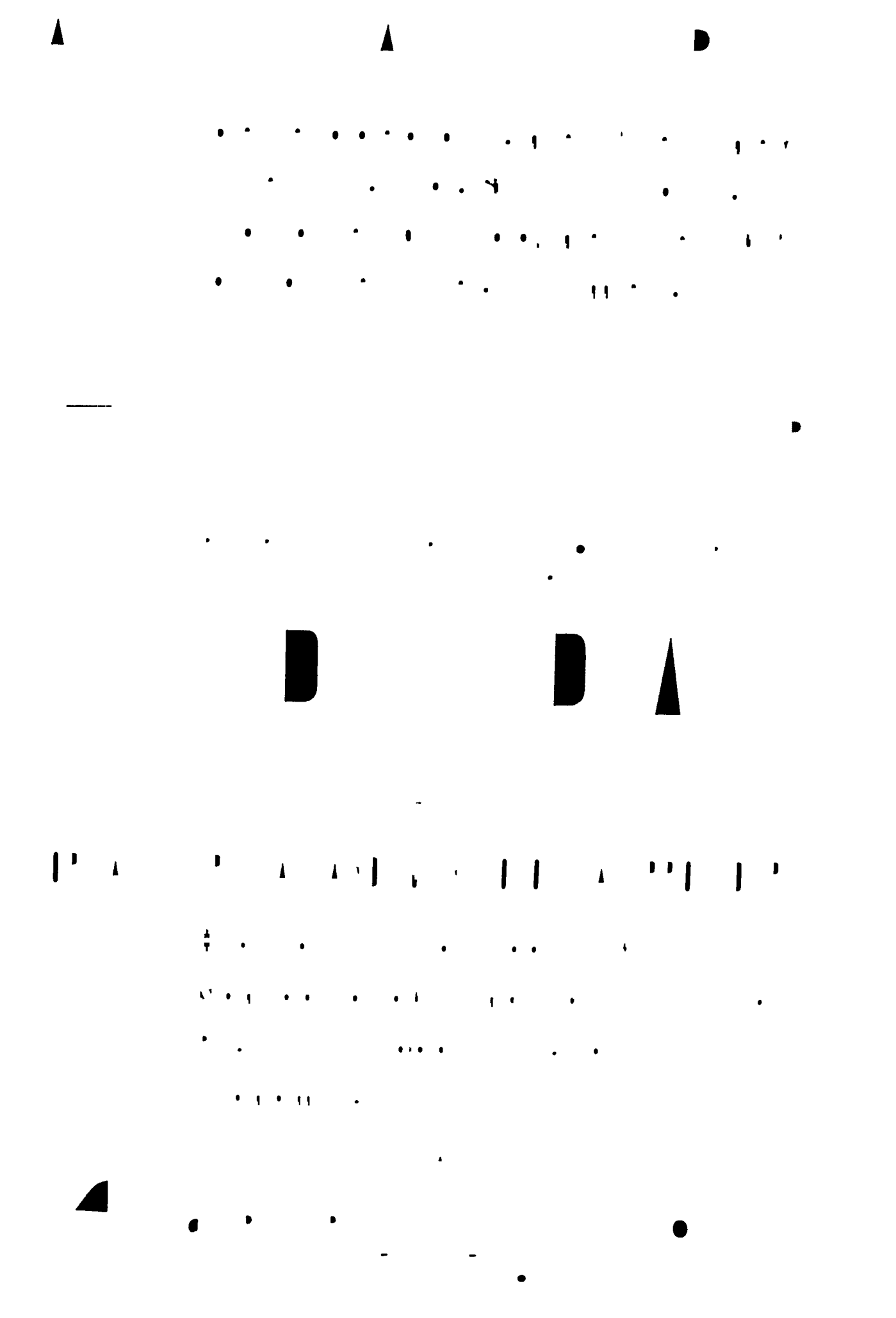
The illustration is one of a series admirably executed by Mr William P Didusch showing the technique of the Pan endoscope The entire series and a complete description of the instrument will be furnished upon request.

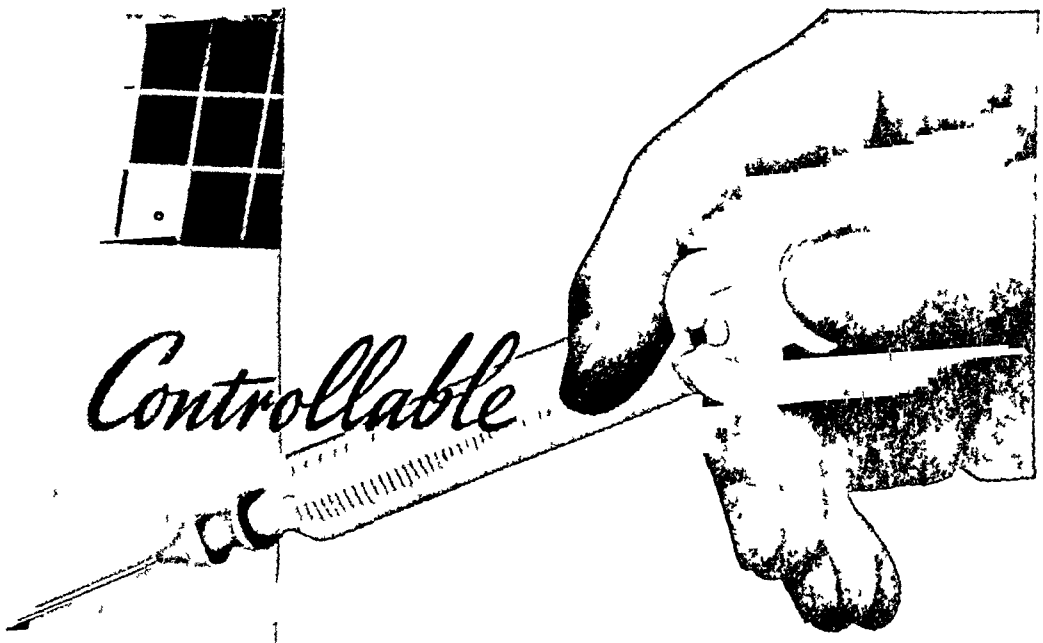
ESTABLISHED IN 1900 BY REINHOLD H WAPPLER

AMERICAN CYSTOSCOPE MAKERS, INC.

FREDERICK C WAPPLER PRESIDENT

450 WHITLOCK AVE NEW YORK U S A

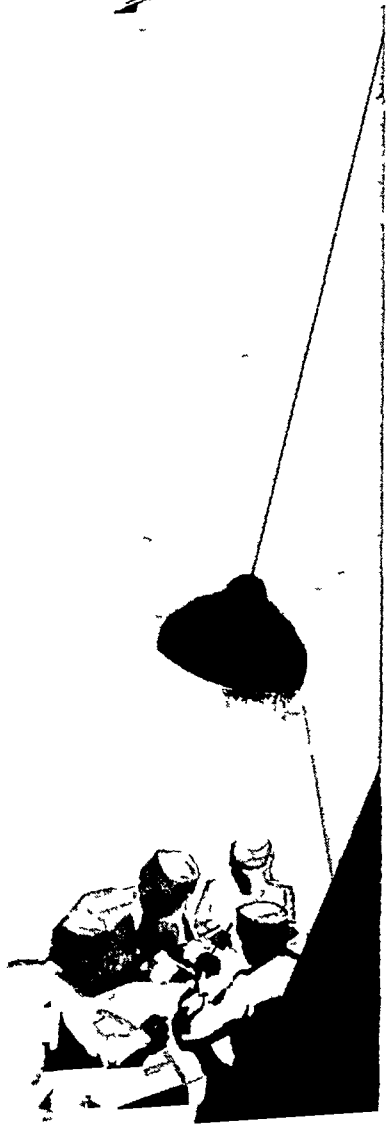




INTRAVENOUS ANESTHESIA

The voluminous and increasing literature demonstrates that Evipal Soluble produces surgical anesthesia quietly and without delay Disintegration of this synthetic in the body is so rapid that awakening takes place after fifteen or twenty minutes without nausea, vomiting or excitement

The newer refinement of administration technic—intermittent injection—makes it possible to maintain control of the effect of Evipal Soluble to a degree which has been compared with that of inhalation anesthetics



EVIPAL SOLUBLE

Evipal Reg U S Pat Off & Canada

Brand of CYCLURAL SODIUM

(Sodium salt of N methylcyclohexenylmethyl barbituric acid)

Evipal Soluble is supplied in ampules containing 0 5 Gm and 1 Gm of the sterile powder

Write for a copy of
'Evipal Soluble Intravenous Anesthetic

WINTHROP CHEMICAL COMPANY, INC.

Pharmaceuticals of merit for the physician

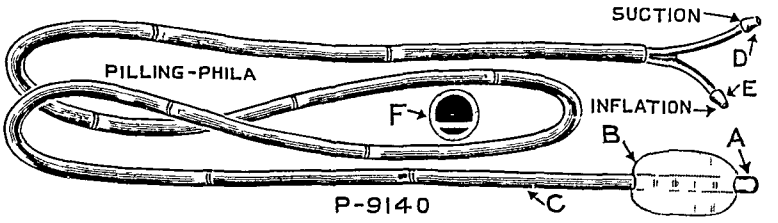
NEW YORK N Y WINDSOR ONT

Factories Rensselaer N Y—Windsor Ont.

590M

DOUBLE LUMEN TUBES FOR SMALL INTESTINAL INTUBATION

T Grier Miller, M D., F A.C P and W Osler Abbott, M D



This double channel tube principle is used for three special purposes First for treating and diagnosing obstructive lesions of small intestines second for controlling patient with intestinal obstruction by enabling him to feed yet to draw off residue above point of blockage third for use after gastro enterostomy

As shown in the illustration one lumen of the tube is used to inflate the balloon the other, entirely independent for feeding or aspiration and inflation of the balloon stimulates peristalsis to propel the apparatus through the whole small intestine in from three to four hours

The terminal balloon may be distended to cause active peristalsis capable of carrying the tip of the tube to the cecum in four hours in a normal individual or at a slower rate in a case of intestinal obstruction

By attaching the lumen leading to the balloon, to a recording instrument a tracing of intestinal activity that may be of diagnostic significance can be obtained

Suction applied to the larger lumen will empty the intestine in a normal case or in a case of intestinal obstruction

The lumen used for suction may also be used for the injection of barium sulphate suspension in making roentgenological studies of small intestinal lesions

P9140 Abbott double lumen tube (No 11) with balloon proximal to perforated metal end see illustration $7 50

P9142 Abbott tube similar to above (No 3) with the balloon distal to the perforated metal end $7 50

P9144 Abbott tube for use after gastro enterostomy (No 12) double lumen with perforated metal and piece but without balloon $6 00

(See Journal of American Medical Association January 4 1936)

GEORGE P PILLING & SON CO
ARCH & 23rd PHILADELPHIA

INDEX TO ADVERTISERS

	Page
SURGICAL SUPPLIES	
American Cystoscope Makers, Inc	5
Kny-Scheerer Corporation	Inside Back Cover
Parker, White & Heyl Inc	9
George P Pilling & Son Co	8
Taylor Instrument Companies	31
LIGATURES	
Gudebrod Bros Silk Co , Inc	10
Davis & Geck, Inc	16
Davis & Geck Inc	Insert 8-9
Johnson & Johnson	15, 32
C De Witt Lukens	16
X-RAY PLATES	
General Electric X-Ray Corp	21
Patterson Screen Company	27
Radium Emanation Company	4
PHARMACEUTICAL SUPPLIES	
Alba Pharmaceutical Company	6
Anglo-French Drug Co , Inc	Inside Front Cover
Armour Laboratories	25
Coca-Cola	26
Cutter Laboratories	3
E Fougera & Co Inc	19
Hoffmann-LaRoche, Inc	12
Eli Lilly & Company	13
Loeser Laboratory	Back Cover
Mallinckrodt Chemical Works	29
Petrolagar Laboratories, Inc	11
Purdue Frederick Company	Inside Back Cover
Schering & Glatz, Inc	23
J Sklar Mfg Company	Back Cover
E R Squibb & Sons	14
Winthrop Chemical Co , Inc	7
Zonite Products Corp	17
HOTELS	
Benjamin Franklin	22
Chalfonte-Haddon Hall	22
Hotel Roosevelt	30
PUBLISHERS	
Journal of Bone and Joint Surgery	24
Lea & Febiger	20
J B Lippincott Company	18, 26
SCHOOLS	
Cook County Graduate School of Medicine	26
Chicago Post-Graduate School of Surgery	10



LANFRANCHI OF MILAN, driven from his native city for political reasons, became associated in 1295 with the College de St Côme in Paris Here his straightforward style of lecturing and his innovation of bedside instruction soon attracted hundreds of students Lanfranchi was the first to describe concussion of the brain, and he differentiated between carcinoma and hypertrophy of the female breast In treating injured nerves he distinguished between longitudinal wounds and complete transverse separation, in the former advising suture of the skin wound only, and in the latter union of the divided nerve with fine sutures

D&G Sutures
"THIS ONE THING WE DO"
DAVIS & GECK INC

Special D&G Sutures

WITH SWAGED-ON ATRAUMATIC NEEDLES

THIS group of products comprises over a hundred suture and needle combinations specially designed for specific procedures, particularly those in which minimized suture trauma and the convenience of needles which cannot possibly become unthreaded, are desirable A few products from this group are shown on these pages Full information on others may be obtained from your dealer or by mail from us, upon request

Intestinal Sutures

KALMERID plain or chromic catgut, celluloid-linen or silk with Atraumatic needles in the several types indicated integrally affixed Suture lengths 36 inches for products 1342, 1352, 1372 and 1542, all others 28 inches

THERMO-FLEX *(non-boilable)*

Plain Catgut

NO		NEEDLE	DOZEN
1501	Straight Needle	A-1	$3 60
1503	3/8-Circle Needle	A-3	4 20
1504	Small 1/2-Circle Needle	A-4	4 20
1505	1/2-Circle Needle	A-5	4 20

20-Day Chromic Catgut

1541	Straight Needle	A-1	$3 60
1542	Two Straight Needles	A-1	4 20
1543	3/8-Circle Needle	A-3	4 20
1544	Small 1/2-Circle Needle	A-4	4 20
1545	1/2-Circle Needle	A-5	4 20

CLAUSTRO-THERMAL *(boilable)*

Plain Catgut

1301	Straight Needle	A-1	$3 60
1303	3/8-Circle Needle	A-3	4 20
1304	Small 1/2-Circle Needle	A-4	4 20
1305	1/2-Circle Needle	A-5	4 20

20-Day Chromic Catgut

1341	Straight Needle	A-1	$3 60
1342	Two Straight Needles	A-1	4 20
1343	3/8-Circle Needle	A-3	4 20
1344	Small 1/2-Circle Needle	A-4	4 20
1345	1/2-Circle Needle	A-5	4 20

Intestinal Sutures *(cont'd)*

Celluloid-Linen

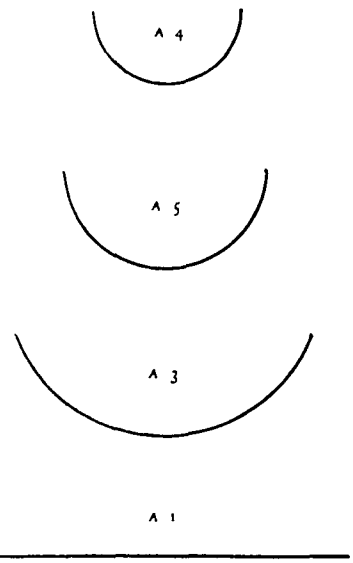
NO		NEEDLE	DOZEN
1351	Straight Needle*	A-1	$3 60
1352	Two Straight Needles*	A-1	4 20
1354	Small 1/2-Circle Needle*	A-4	4 20

Black Silk

1371	Straight Needle*	A-1	$3 60
1372	Two Straight Needles*	A-1	4 20
1374	Small 1/2-Circle Needle*	A-4	4 20

Sizes 00 0 1, except *00 0 only

In packages of 12 tubes of a kind and size



DIAMETERS 022 TO 026

Eye Sutures

FINE sizes of plain, 10-day chromic catgut, and black silk with small Atraumatic needles Suture length 18 inches except as noted Boilable

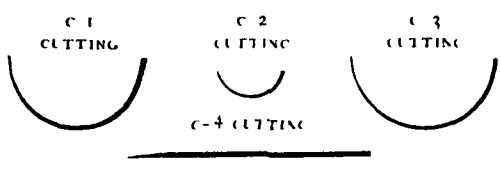


NO	MATERIAL	SIZE	NEEDLE
1661	Black Silk	6-0	B-3
1663	Plain Catgut	4-0	B-5
1665	Black Silk	6-0	B-1
1665	Black Silk	4-0	B-1
1667	Plain Catgut	3-0	B-4
1669	10-Day Catgut	4-0	B-5
1669	10-Day Catgut	3-0	B-5
1669D	10-Day Catgut †	4-0	B-5
1669D	10-Day Catgut †	3-0	B-5
	DOUBLE ARMED		
1662	Black Silk *	6-0	B-3
1664	Black Silk *	6-0	B-1
1664	Black Silk *	4-0	B-1
1666	Plain Catgut *	3-0	B-4
1668	10-Day Catgut *	4-0	B-5
1668	10-Day Catgut *	3-0	B-5
1668D	10-Day Catgut †	4-0	B-5
1668D	10-Day Catgut †	3-0	B-5

* 12 inches † 9 inches

Package of 12 tubes of a kind $4 20

Cleft Palate and Harelip Sutures



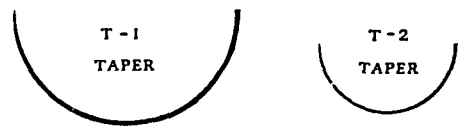
NO	MATERIAL	SIZE	NEEDLE
1751	Kal dermic	00	C-1
1752	Aluminum-Bronze Wire	00	C-1
1753	Black Braided Silk	000	C-2
1754	Aluminum-Bronze Wire	00	C-4
1755	Kal-dermic	00	C-3
1758	Aluminum-Bronze Wire	00	C-3

Suture length 18 inches

Package of 12 tubes of a kind $4 20

Thyroid Sutures

THERMO-FLEX (*non-boilable*) or Claustro-Thermal (*boilable*) catgut, and black braided silk with half-circle, taper point Atraumatic needles Suture length 28 inches



NO	MATERIAL	SIZE	NEEDLE
1635	Non-Boilable Plain Catgut	0	T-1
1625	Boilable Plain Catgut	0	T-1
1624	Black Braided Silk	000	T-2

Package of 12 tubes of a kind $4 20

Plastic Sutures

FINE sizes of Kal-dermic, silk and silkworm gut with small, cutting point Atraumatic needles Suture length 18 inches Boilable



NO	MATERIAL	SIZE	NEEDLE
1651	Kal-dermic	8-0	B-1
1651	Kal-dermic	6-0	B-1
1652	Kal-dermic	8 0	B-5
1652	Kal-dermic	6-0	B-5
1652	Kal-dermic	4-0	B-5
1653	Black Silkworm	4-0	B-1
1655	Kal-dermic	4-0	B-2
1658	Black Silk	4-0	B-2

Package of 12 tubes of a kind $4 20

Other D&G Sutures

SPECIAL needled sutures are also prepared for dental, tonsil, circumcision, obstetrical, ureteral, renal, nerve, artery, and emergency work These are in addition to our complete line of unneedled sutures embracing catgut, ribbon gut, kangaroo tendons, and a variety of other non-absorbable materials

DISCOUNTS ON QUANTITIES

DAVIS & GECK, INC , 217 DUFFIELD STREET, BROOKLYN, NEW YORK

Copyright 1938 Davis & Geck, Inc Printed in U S A



"A balance of qualities..."

NEW types and varieties of sutures are constantly needed to meet advances in surgery, but the fundamentals of suture dependability remain unchanged

Sutures still should be not only easy to handle but correct in every phase of behavior No single feature nor point of merit can accomplish this it demands a *combination* of various qualities

Therefore, in every new product and in every development by our scientific staff the first concern is a proper ratio of vital characteristics

The special feature of each product is developed to the highest degree, but always with due regard to other qualities equally essential to correct function

This policy, which involves the annual consumption of more than 250,000 tubes in experimental work and tests, gives assurance that D & G Sutures invariably possess the correct *balance of qualities*

D & G Sutures

DAVIS & GECK, INC - - BROOKLYN, NEW YORK, U S A

A NEWCOMER!



The BARD-PARKER HEMATOLOGICAL CASE

A compact and convenient equipment for obtaining blood for red, white and differential blood count, at the bedside, and safely conveying the diluted blood, microscope slides or cover glass to the office or laboratory Designed by Dr J Alfred Wilson, Meriden, Conn

This ideal pocket size Case is equipped with CASE of durable molded material in ivory color, LANCET, stainless steel, triangular pointed, kept constantly sterile as it is made integral with cap of B-P Germicide vial, PIPETTES, one red and one white blood cell diluting pipette, MOUTHPIECE and TUBE, 3 SOLUTION VIALS for Germicide and red and white cell diluents, 2 standard BLOOD SLIDES, 4 COVER GLASS with PATIENT IDENTIFICATION ENVELOPES, COTTON.

B-P Pipettes are securely mounted between rubber faced spring compression plungers and set facings Thus pipettes are sealed against leakage

Featuring "C.F." (Correction Factor) re-tested BARD-PARKER PIPETTES

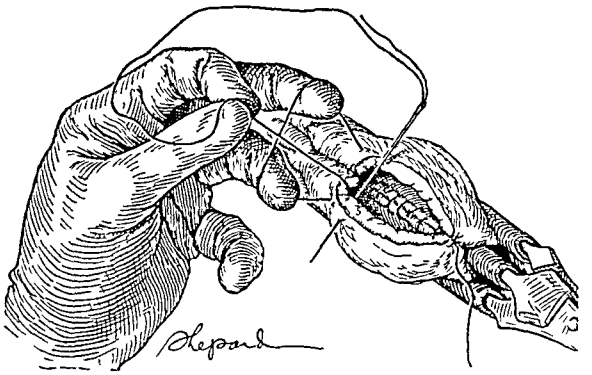
To each B P Pipette, registered by number, is attached a re test certificate giving the "Correction Factor," invaluable in obtaining greater interpretive accuracy

Price of Complete Case $7.50

PARKER, WHITE & HEYL, Inc.
Danbury Connecticut

A BARD-PARKER PRODUCT

Actual Practice in Surgical Technique



Method of Holding Connel Stitch From Principles of Operative Surgery, by A V Partipilo, M D

Special Courses—

Urology Cystoscopy Orthopedic Surgery Thoracic Surgery Surgical Pathology Laboratory Diagnosis and Technique Bronchoscopy Eye, Ear, Nose, and Throat Goiter Surgery Gynecology Surgical Anatomy Proctology

Visitors always welcome

CHICAGO POST-GRADUATE SCHOOL OF SURGERY

(Formerly—Laboratory of Surgical Technique)

(Incorporated not for profit)

Near Cook County Hospital

1 Two Weeks Surgical Technique Course rotary course continued throughout the year Combines Clinical Teaching and ACTUAL PRACTICE BY THE STUDENTS under competent supervision A review of the necessary Surgical Anatomy is embraced in the work

2 General Surgery One to Three Months Course designed for students who wish to review more thoroughly Anatomy, Surgical Pathology Surgical Technique, and Clinical Surgery

3 Special instruction and practice in the technique of one or more operations is available to surgeons who wish to review the Anatomy and Technique of certain operations

Personal Instruction Actual Practice Operating Rooms, Equipment and Method of Teaching Ideal and Unsurpassed For information as to Courses, Fees, Registration Requirements Etc, address

A V PARTIPILO, M D, F A C S, Director, 1950 S Ogden Ave, Chicago Ill, Phone Haymarket 7044

A Step Forward in Dermal and Tension Suturing

You will benefit greatly, and of equal importance, your patients will benefit greatly through the use of a newly engineered and thoroughly efficient Dermal Suture Now being successfully used by many of the best hospitals whose names we can give you on request

CHAMPION DERMAL SUTURES are fairly stiff, *but not wiry*—they cannot crack nor splinter, they are benign to skin and tissue, contain no acids or detrimental chemicals

Quicker wound healing is assured and, of utmost importance, knots can be more easily tied but these KNOTS CANNOT SLIP

A liberal supply for testing purposes FREE for the asking

Dermal
Sizes 6 0—0—2—5

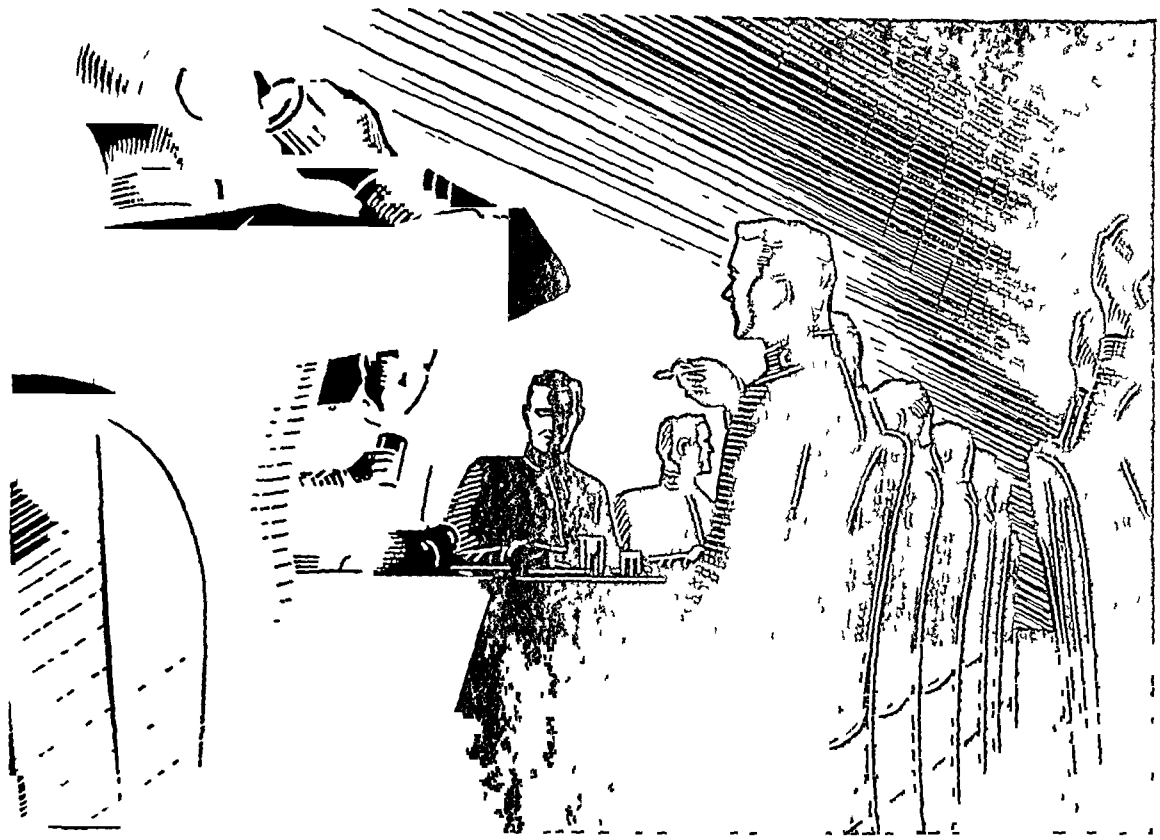
Tension
Sizes 8—9—12—19

State sizes wanted

GUDEBROD BROTHERS SILK CO., Inc.

Founded 1870

12 South 12th St. **Philadelphia, Pa**



DIET

When the impulse to defecate is lessened due to improper diet or lack of discipline, the fecal matter usually becomes dehydrated and impacted in the bowel To simplify the problem of bowel regularity, Petrolagar may be prescribed to advantage, as it assists in the regulation of bowel movement Petrolagar mixes intimately with the bulk of the stool to induce a soft, easily passed mass By reason of its pleasant taste and mild but thorough action, Petrolagar is agreeable to patients of all ages Five types of Petrolagar provide a choice of laxative medication suitable for the individual patient Petrolagar Laboratories, Inc , 8134 McCormick Boulevard, Chicago, Illinois

Petrolagar — Liquid petrolatum 65 cc emulsified with 0 4 Gm. agar in a menstruum to make 100 cc



Please mention ANNALS OF SURGERY when writing advertisers



CAL-C-TOSE 'ROCHE'

FORMERLY KNOWN AS CAL-C-MALT

The little girl naturally admires the external evidence of physical prowess in her big brother Ofttimes the parents, too, look only at the surface But the doctor always looks deeper, and must think of the need for *maintaining* nutrition, in grown-ups as well as in growing children, and for *restoring* strength and well-being to those who are depleted by illness and overwork Cal-C-Tose is a tonic food, highly effective in accomplishing these purposes

Cal-C-Tose derives its tonic food properties not only from its nutritive elements, but from its generous content of vitamin C, in addition to dicalcium phosphate, vitamin B, and beneficial minerals—all incorporated in the finest quality chocolate base

HOFFMANN-LA ROCHE, INC., NUTLEY, N.J.

CAL-C-TOSE IS
RICH IN VITAMIN C

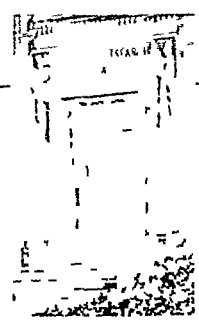
Each dose, 2 teaspoonfuls, contains 50 mg of pure, synthetic cevitamic acid, 'Roche', equivalent to the fresh juice of two medium size oranges

Mix CAL C TOSE with milk
It makes a delicious drink



Send for a professional sample

THE CRUCIAL TEST—Laboratory tests are not always decisive Clinical trial is essential really to prove the merit of new drugs The Lilly trade-mark on pharmaceuticals and biologicals is assurance of conscientious testing both in the clinic and in the laboratory



'Sodium Amytal' (Sodium Iso-amyl Ethyl Barbiturate, Lilly) has become the standard for comparison among hypnotics Probably no barbiturate has had more extensive clinical trial and none has emerged from years of therapeutic use with a more enviable record for dependability and safety

Supplied in pulvules (filled capsules) and in ampoules (parenteral injection should be restricted to convulsive conditions)

ELI LILLY AND COMPANY

INDIANAPOLIS, INDIANA, U S A



THE CLINICAL BACKGROUND of an anesthetic agent is an important factor in its acceptance Ninety years of use have shown that no other anesthetic agent exceeds the value of ether from the standpoint of its safety, controllability, adaptability, and muscular relaxation For this reason it continues to be the most widely used anesthetic agent

In 1853, Dr E R Squibb pioneered in the production of pure anesthetic ether by originating the continuous distillation process He made an ether which was safe for anesthesia *The original scientific tradition has been maintained to this day*

The production of Squibb Ether is mechanically controlled by unerring, sensitive automatic devices It is packaged in patented copper-lined containers to protect its purity indefinitely It is the only ether so packaged

Surgeons and anesthetists everywhere prefer and specify Squibb Ether because of its proved dependability through many decades of use Squibb Ether is used in over 85% of American Hospitals and in millions of cases every year

For literature address Anesthetic Div, E R Squibb & Sons, 745 Fifth Ave, New York

SQUIBB ETHER

Please mention ANNALS OF SURGERY when writing advertisers.



Photograph above shows partial view of Johnson Suture Corporation Building, 2212 South LaSalle Street, Chicago, Ill This is a wholly-owned subsidiary of Johnson & Johnson

The house... *"built on a rock"*

YEARS ago Johnson & Johnson discovered that partial control of suture production was comparable to the stability of the house "built upon the sand" In 1921, in the Chicago packing house district, the plant pictured above was established From daily receipt of raw sheep's intestines to final sterilization every step in the production of Johnson & Johnson Catgut is under the control of the company's own scientists, executives and craftsmen

Economically, a surgical catgut manufacturing operation cannot exist without an outlet for tennis gut, because a large proportion of the raw sheep gut is not adaptable to surgical catgut manufacture Therefore, at the J & J plant this material is fabricated into Johnson's Chrome Twist, the most celebrated tennis gut in the world, used by all leading players

For surgical catgut, J & J maintains a full-time scientific staff which is constantly engaged in extensive research work

This single ownership control of every step of manufacture gives the surgeon the benefit of a superlative finished product, produced under conditions and by exclusive methods unparalleled anywhere else in the world

Johnson & Johnson
NEW BRUNSWICK N J CHICAGO ILL

MANUFACTURERS OF SURGICAL SUTURES SINCE 1887

Please mention ANNALS OF SURGERY when writing advertisers

Lukens Sterile Catgut

TRADE (Bartlett Process) MARK



Make the Test Yourself

Compare It Point for Point With any Other Catgut

We Will Send the Samples

Sizes 00-4 Plain

C. DE WITT LUKENS CO.
4908 Laclede Ave.
ST. LOUIS, MO., U.S.A.

Sizes 00-4 Tanned

"THIS ONE THING WE DO"



SUTURES

DAVIS & GECK, Inc, Brooklyn, N Y

ANNALS OF SURGERY

VOL 107 MARCH, 1938 No 3

ACUTE ILEUS *

ANALYSIS OF ONE HUNDRED THIRTY CASES OPERATED UPON AT THE PRESBYTERIAN HOSPITAL, NEW YORK CITY FROM 1932 TO 1935, INCLUSIVE

FREDERICK T VANBEUREN, JR, M D, AND BEVERLY C SMITH, M D
NEW YORK

In a recent report[1] on the mortality in cases of acute ileus the authors tabulated the results for 20 years (1916–1935, inclusive) by four-year periods and showed that there had been a reduction in general mortality from 66 6 per cent in the first four-year period (1916–1919, inclusive) to 27 6 per cent in the last four-year period (1932–1935, inclusive) at the Presbyterian Hospital in New York City

The most striking reduction occurred in this last four-year period when the average mortality was found to be about 20 per cent less than in the preceding four-year period A more complete analysis of this series of 130 cases seemed worthwhile in an attempt to account intelligently for the better results A careful study was made of each case by both authors and the whole series was first divided into three groups, classified according to type (1) Complete intestinal obstruction, (2) incomplete intestinal obstruction, and (3) paralytic ileus The criteria for this classification were as follows

(*a*) In the small bowel, obstruction was considered complete if the lumen was distended above and collapsed below the constriction

(*b*) In the large bowel, obstruction was considered complete if the lumen was distended above and at the point of constriction was not more than

TABLE I

COMPARISON OF MORTALITY OF GROUPS CLASSIFIED ACCORDING TO TYPES IN A SERIES OF 130 ACUTE ILEUS CASES

	Total No	Late Case Per Cent	Recovered	Died	Mortality Per Cent
Series	130	60%	94	36	27 6%
Complete obstruction	91	63%	78	13	14 3%
Incomplete obstruction	26	88%	15	11	42 3%
Paralytic ileus	13	69%	1	12	92 3%

* Read before the New York Surgical Society, October 13, 1937 Submitted for publication October 4, 1937

3 millimeters in diameter (as reported from the Surgical Pathology Laboratory or found at autopsy)

(*c*) The case was considered a paralytic ileus if the intestines were more or less uniformly distended, diffuse peritonitis was present and no obstruction was found Recent adhesions angulated the bowel and caused complete or partial obstruction in 21 cases These were classified as intestinal obstruction (mechanical ileus) whether or not active peritonitis was present, and are really a combination of mechanical and paralytic factors

A comparison of the mortality in these groups is shown in Table I

COMMENTS ON TABLE I

(1) This analysis and classification as to type of the ileus demonstrates strikingly how much more serious a condition paralytic is than mechanical ileus

(2) It indicates that a patient's chances are better with a complete obstruction than with an incomplete obstruction

(3) It indicates that the complete obstruction and the paralytic ileus cases are operated upon earlier than the incomplete obstructions when the symptoms appear less urgent and progressive

(4) It shows conclusively that the group of complete obstructions is responsible for the total reduction of the mortality of the whole series This, the largest of the three groups, has the smallest percentage of late cases and the lowest mortality

Many other reports of similar series cases have shown striking variations in mortality of separate groups classified according to the exciting cause or mechanism of the ileus condition The next step, therefore,

TABLE II

ANALYSIS OF GROUPS OF ACUTE ILEUS CASES, CLASSIFIED ACCORDING TO EXCITING CAUSE OF THE ILEUS

	Recovered	Died	Mortality Per Cent
(I) *Acute Mechanical Ileus—Complete Obstruction*			
41 cases of old postoperative adhesions or bands (2 with gangrene of bowel)	40	1	2 5%
15 cases of recent postoperative adhesions (recent peritonitis)	13	2	13 3%
12 cases of carcinoma of colon	9	3	25 0%
17 cases of strangulated hernia (7 with gangrene)	11	6	35 3%
4 cases of volvulus of intestine	3	1	25 0%
1 case of intussusception	1	0	0 0%
1 case of gallstone	1	0	0 0%
91			
(II) *Acute Mechanical Ileus—Incomplete Obstruction*			
6 cases of old postoperative adhesions or bands	4	2	33 3%
6 cases of recent postoperative adhesions (recent peritonitis)	4	2	33 3%
12 cases of neoplasm of intestine (10 carcinoma of colon)	5	7	58 3%
1 case of volvulus of intestine	0	1	100 0%
1 case of syphilis of intestine	1	0	0 0%
26			

(III) *Paralytic Ileus—No Obstruction Found*

5 cases of acute diffuse peritonitis following acute appendicitis	1	4	92 3%
3 cases of acute diffuse peritonitis following resection of carcinoma	0	3	
1 case of acute diffuse peritonitis following acute pancreatitis	0	1	
1 case of acute diffuse peritonitis following acute diverticulitis	0	1	
1 case of acute diffuse peritonitis following strangulated hernia	0	1	
1 case of acute diffuse peritonitis following acute salpingitis	0	1	
1 case of acute diffuse peritonitis following mesenteric thrombosis	0	1	
13			

was to divide out three primary groups of complete obstruction, incomplete obstruction and paralytic ileus into subgroups classified on a basis of causal mechanism Table II shows the mortality percentage in these subgroups

COMMENTS ON TABLE II

(1) It will be seen that nearly one-half of the complete obstruction group were caused by old peritoneal bands or adhesions, requiring relatively brief and simple operations On the other hand, nearly one-half the cases in the incomplete obstruction group were due to neoplasms requiring more prolonged and difficult operative procedures

(2) It is at once evident that the large subgroup of cases due to old postoperative peritoneal adhesions or bands with their very low average mortality is responsible for the low general mortality of the primary group of complete intestinal obstruction

(3) It is equally evident that the large proportion of intestinal neoplasms, with their high death rate, is largely responsible for the high general mortality of the primary group of incomplete intestinal obstruction

(4) It is more difficult to explain why the 12 neoplasms causing complete obstruction had a mortality only one-half that of the neoplasms causing incomplete obstruction It is also difficult to see why old adhesions causing complete obstruction had so small a mortality compared with those causing incomplete obstruction It may have been due to individual variations or perhaps to the already noted fact that the incomplete obstructions were in general operated upon later than the complete obstructions

(5) Cases due to recent postoperative adhesions (frequently complicated by a persisting peritonitis) had a much higher mortality when the obstruction was incomplete It is not convincing but it suggests that peritonitis is an exceedingly serious complication of acute ileus

(6) This suggestion is markedly emphasized by a glance at the paralytic ileus group, with one single recovery out of 13 cases when associated with acute, diffuse peritonitis following various causes

(7) Because one finds similar variations in mortality dependent upon the cause or exciting mechanism of the ileus in reports by other writers, it would appear that, in order to compare fairly the results in one series of ileus cases with another, each series must first be analyzed in three ways

(*a*) According to the percentage of late cases

(*b*) According to the cause or mechanism

(*c*) According to type, complete or incomplete mechanical or paralytic ileus If this is not done, three criteria for intelligent judgment have been omitted

TABLE III

ANALYSIS OF ADJUVANT TREATMENT IN 91 CASES OF ACUTE ILEUS OPERATED UPON AT THE PRESBYTERIAN HOSPITAL, 1932–1935, INCLUSIVE

Diagnostic Roentgen Ray	Type of Anesthesia			Gastric Lavage or Nasal Tube	Replacement of Fluids and Electrolytes	Use of Peristaltic Drugs	Rectal Treatments
Taken on all patients where diagnosis was not obvious Roentgenograms were positive in 92%, negative or doubtful in 8% of cases in which obstruction was proved at operation	Local	General	Spinal	Used only in 40 cases	All but 3 patients had 2,200 cc average given q d for an average time of 5 days postop Fluid used was generally normal saline, occasionally hypertonic saline, very rarely 5% glucose	60 patients had peristaltic drugs postop An average of 4 to 5 doses a day for an average time of 5 days	67 patients had colon lavage
	15 cases	36 cases	40 cases				
	Mort 27%	Mort 33%	Mort 10%	Mort 25%		Mort 11 7%	Mort 15%
						31 patients were given none	24 patients had none
						Mort 33 3%	Mort 37 5%

The results were so much better in the group of cases of complete obstruction in the series we are reporting here, that we made an analysis of the adjuvant treatment in these 91 cases, seeking to discover further light on the cause of the improvement in mortality This analysis is shown in Table III

COMMENTS ON TABLE III

(1) *Diagnostic Roentgenograms* in three positions (supine, and lying on right and left sides), were taken in 78 cases where the diagnosis was not obvious In 92 per cent of these cases they made the diagnosis positive at once, and obviated the delays of further investigation, thus predisposing to earlier operation and better results

(2) *Anesthesia* It would appear from this table that local anesthesia, with a mortality of 27 per cent in the cases where it was used, was dangerous The appearance is deceptive, however Local anesthesia was used in a few cases of strangulated hernia but it was employed mostly for the preliminary cecostomy in obstruction due to carcinoma or for secondary enterostomy in cases where the relief operation had not been completely successful Such cases have what might be called a natural high mortality and it would be unfair to ascribe it to the local anesthesia

General Anesthesia was used in 36 of the operations with a mortality of 33 per cent, avertin supplemented by nitrous oxide and oxygen 15 times, nitrous oxide and oxygen supplemented by ether 14 times, avertin supplemented by local anesthesia three times, and nitrous oxide and oxygen supplemented by local four times It was used in most of the carcinoma cases where a later resection followed the preliminary cecostomy

Spinal Anesthesia (generally novocain [100–200 mg] or pantocain 2 cc) was used altogether 40 times, approximately in the same number of herniae, adhesion-obstructions and peritonitis cases as was general anesthesia It was used in only half as many cases of carcinoma The mortality of ten per cent contrasts favorably with that of the general anesthesia, particularly as they were used in similar types of cases

Certainly there is a real advantage in having a patient conscious, if he is liable to vomit Theoretically, there is also an advantage in having the peristaltic stimulation of the bowel which often follows spinal anesthesia

(3) *The Nasal Stomach Tube* for suction and irrigation was used comparatively little, until the year 1935 It was reported as being effective and helpful but was used in so small a percentage of the patients that no more definite report can be made It is now being used much more frequently

(4) *Replacement of Fluid and Electrolytes* This procedure has been followed for a number of years but not so frequently and persistently as it has been for the past four or five years The smallest amount given any one patient was 1,000 cc of saline in one day The largest total amount given to any one patient was 77,000 cc in 30 days Administration was by hypodermoclysis, by repeated infusions or by continuous infusion, supplemented by proctoclysis

(5) *Peristaltic Drugs* These have been used much more frequently during the past four or five years as a postoperative routine, except in cases where lower bowel resection had been done Two-thirds of the patients were given them They were combined with rectal treatment, usually colon lavage, less frequently enemata or irrigations The smallest amount given to any patient was six doses of pitressin, in one day The largest amount was 64 doses, in 13 days Pitressin was most frequently used, sometimes prostigmine, occasionally pituitrin and rarely peristaltin

(6) *Rectal Treatment* Sixty-seven patients received postoperative rectal treatment Twenty-four patients did not The latter group comprised those who had had colon resection and those whose peristalsis reestablished itself automatically

It is unwise to be too definite in commenting on these factors of treatment but one

feels justified in saying that the following *appear* to have had a favorable effect on the mortality

(1) The routine use of diagnostic roentgenologic examination
(2) More frequent use of spinal anesthesia
(3) The more generous replacement of fluid and NaCl
(4) The more frequent administration of peristaltic drugs after operation

We believe that there is another important factor making for improvement, namely, the greater general interest in, and the better understanding of, these cases which have resulted from their more intensive study

OPERATIVE TREATMENT

The operative treatment in these 91 cases varied from the cutting of a single obstructing band to an extensive resection of the colon for carcinoma, and was too varied to classify, usefully, with the exception of the operation of enterostomy, which was performed 42 times in 39 cases

Table IV exhibits the analysis as to time (primary, done at the time of relief operation, or preliminary to it, and secondary, done after relief operation, to supplement it), as to method (Witzel or Kader), and as to location (jejunum, ileum, colon) The mortality percentages stated are not of great value because the number of cases is so small

TABLE IV

ANALYSIS OF 42 CASES OF ENTEROSTOMY PERFORMED UPON 39 PATIENTS WITH COMPLETE OBSTRUCTION AT THE PRESBYTERIAN HOSPITAL, 1932–1935, INCLUSIVE

Time		Method		Location		
Primary	Secondary	Witzel	Kader	Jejunum	Ileum	Colon
30 cases	12 cases	21 cases	21 cases	21 cases	6 cases	15 cases
23 3% mortality	23 0% mortality	15% mortality	23 8% mortality	23 8% mortality	33 3% mortality	20% mortality

COMMENTS ON TABLE IV

(1) These 39 patients upon whom enterostomy or colostomy was performed were undoubtedly the more seriously sick among the 91 cases analyzed as to treatment They included the great majority of the carcinoma and peritonitis cases, which accounts in part for their high average mortality

(2) Their average mortality was 28 2 per cent as contrasted with an average mortality of 3 8 per cent among the 52 cases, without enterostomy, in the same group of complete obstructions

(3) All but one of the enterostomies were reported as being effective (from the point of view of discharging bowel contents and relieving intra-intestinal pressure) and only two had to be closed by operation (the gunbarrel type) But there were three cases in which two enterostomies (each) were performed Out of the total 42 operations performed, it would be safe, therefore, to assume that 39 were effective and three unsatisfactory

(4) Because of the small number of cases in each column of this table, and because of modifying conditions, we do not feel justified in drawing any definite conclusions

as to the effect on the mortality percentage of the method used, or the location of the opening

(5) We do, however, believe that the time is important and that a primary enterostomy or colostomy, performed as a part of the release operation (or preliminary to it), is more effectual than a secondary one, performed later to supplement an unsatisfactory release operation And we further believe that in cases of obstruction above the ileocecal junction an opening in the jejunum is better than in the ileum because the upper bowel, being farther away, is less affected by the obstruction and more likely to function effectively in ridding itself of overdistention through the opening

(6) Enterostomy should be thought of, and employed, only as a safety valve to relieve or to prevent overdistention of the bowel by gas or fluid when that is present or expected And it must be remembered that, just as with a safety valve set too low, it may occasionally result in loss of vitally useful contents It has not been employed with sufficient judgment and discretion We still believe that in certain selected cases it is to be recommended provided it is done early enough

(7) The relative ineffectiveness of enterostomy in paralytic ileus and in late cases of obstruction is seen in Table V, where the mortality of enterostomy in cases of complete obstruction is compared with that in cases of incomplete obstruction (most of which were late) and in cases of paralytic ileus

TABLE V

COMPARISON OF RESULTS OF ENTEROSTOMY IN I, COMPLETE OBSTRUCTION, II, INCOMPLETE OBSTRUCTION, III, PARALYTIC ILEUS

	COMPLETE OBSTRUCTION	
I	42 enterostomies (performed on 39 out of 91 cases of complete obstruction)	Mortality 28 2%
	INCOMPLETE OBSTRUCTION	
II	17 enterostomies (performed on 17 out of 26 cases of incomplete obstruction)	Mortality 53 0%
	PARALYTIC ILEUS	
III	10 enterostomies (performed on 10 out of 13 cases of paralytic ileus)	Mortality 90 0%

CAUSES OF DEATH

The list of deaths shown in Table VI emphasizes the well recognized fact that comparatively few cases of mechanical ileus die from the obstruction itself but rather from the complications of the ileus After the obstruction has been relieved most of the deaths are attributable to pneumonia or peritonitis

TABLE VI

ANALYSIS OF CAUSE OF DEATH AND LENGTH OF POSTOPERATIVE SURVIVAL IN 130 CASES OF ACUTE ILEUS OPERATED UPON AT THE PRESBYTERIAN HOSPITAL, 1932–1935, INCLUSIVE

COMPLETE INTESTINAL OBSTRUCTION

Unit Hist	
458538	Strangulated femoral hernia (C Welchii, hemolytic colon B and *Streptococcus viridans* in sac with gangrenous intestine), (herniotomy) 63-year-old woman Died of peritonitis 36 hours postoperative
423898	Strangulated inguinal hernia, (herniotomy) Died pneumonia, 12 days postoperative

TABLE VI (*Continued*)

COMPLETE INTESTINAL OBSTRUCTION (*continued*)

Unit Hist	
81621	Strangulated umbilical hernia, (herniotomy) Died six hours postoperative, probably of cardiac failure (very fat man 5 ft , 4 in , weighing 229 lbs)
350920	Strangulated femoral hernia, (herniotomy) Died nine days postoperative, probably of pneumonia
373120	Carcinoma of sigmoid (spontaneous perforation, acute diffuse peritonitis), (exploratory celiotomy) Died six days postcecostomy of peritonitis
384828	Pelvic abscess, (drainage) Died 37 days postoperative, probably asthenia (75 years old)
394664	Acute appendicitis, intestinal obstruction by adhesions, (release of adhesions, drainage of abscess) Died of suppurative pyelophlebitis 30 days postoperative
398018	Strangulated inguinal hernia, gangrenous intestine, (gunbarrel resection) Died 18 hours postoperative, probably of peritonitis
400609	Meckel's diverticulitis, foreign body ileus, (resection) Died peritonitis and pneumonia 11 days postoperative
389690	Carcinoma of cervix, (radium, ileocolostomy) Died 67 days postoperative of carcinoma and radium necrosis
315483	Carcinoma of stomach, (resection, adhesions, volvulus) Died three days postoperative of peritonitis
335827	Carcinoma of sigmoid, (cecostomy, colostomy) Died of pneumonia, 16 days postoperative (old cardiac, 69 years old)
333373	Strangulated femoral hernia, with gangrene of ileum, (partial enterectomy, ileostomy) Died 17 days postoperative of pneumonia (85 years old)

INCOMPLETE INTESTINAL OBSTRUCTION

369406	Carcinoma cecum, (4 hour resection) Died five days postoperative of peritonitis
421285	Carcinoma stomach, (resection, peritoneal abscess) Obstruction 15 days postoperative Died of carcinoma and peritonitis 27 days postoperative
458227	Carcinoma of colon, (no resection) Died 13 days postcecostomy of uremia and lobular pneumonia
347720	Carcinoma sigmoid, recurrent, (resection) Died 21 days postoperative of pneumonia
379322	Acute appendicitis Acute diffuse peritonitis, (jejunostomy, drain abscess, appendicectomy) Died 16 days postoperative of pneumonia
330777	Carcinoma of sigmoid, (cecostomy) Died three days postoperative of pneumonia (73 years old)
369480	Reticulum cell sarcoma of colon and ileum, (exploratory celiotomy, ileostomy and colostomy) Died 14 days postoperative of sarcoma of peritoneum of bowels (Age 66)
258705	Ulcer of stomach, (Polya resection of stomach) Postoperative kinking of jejunum and leakage of suture line Died of peritonitis and ileus 12 days postoperative

TABLE VI (*Continued*)

INCOMPLETE INTESTINAL OBSTRUCTION (*continued*)

Unit Hist	
349836	Ventral hernia and postoperative adhesions, (repair of hernia and division of adhesions jejunostomy) Died 15 days postoperative of peritonitis of unknown origin
335621	Carcinoma of transverse colon and rectum, (resection of transverse colon. Abdominal perineal proctectomy eight days later) Died three days after second operation
333488	Carcinoma of sigmoid with metastases and pul tbc , (cecostomy, palliative) Died 16 days postoperative of pneumonia

PARALYTIC ILEUS

386886	Strangulated femoral hernia, (herniotomy wound disruption, peritonitis) Died 19 days postoperative of peritonitis
339700	Mesenteric thrombosis, gangrenous ileum, acute diffuse peritonitis, (resection) Died, extension of thrombosis, two days postoperative
384874	Carcinoma of rectum, (abdominal perineal resection) Died 19 days post resection, probably of peritonitis and paralytic ileus
341572	Pelvic abscess with acute diffuse peritonitis, (drainage of abscess, ileostomy) Died of peritonitis (following perforation of ileum by enterostomy tube) four days postoperative
419365	Acute appendicitis, disruption of operative wound, (appendicectomy, repair of disrupted wound, jejunostomy) Died six days postoperative of pneumonia and peritonitis
227507	Acute pancreatitis, acute diffuse peritonitis, (cholecystectomy, chronic cholecystitis with calculi, choledochotomy) Died nine days postoperative of peritonitis
339864	Carcinoma of rectum, (general arteriosclerosis), (colostomy, enterostomy) Died of paralytic ileus four and one-half days postoperative (Age 71)
347615	Acute appendicitis, acute diverticulitis with abscess, acute diffuse peritonitis (drainage of abscess, cecostomy, jejunostomy) Died 15 days postoperative of peritonitis
433333	Carcinoma of cecum with metastases, (resection of cecum, jejunostomy, revision of jejunostomy) Died four days postoperative of shock and peritonitis
350959	Acute salpingitis, acute diffuse peritonitis, (appendicectomy, salpingoöphorectomy) Died 24 hours postoperative of peritonitis and shock
402686	Diverticulitis of sigmoid, acute diffuse peritonitis, (exploratory celiotomy, ileostomy) Died six days postoperative of peritonitis
336060	Acute appendicitis, acute diffuse peritonitis, (celiotomy with drainage) Died of pneumonia and uremia five days postoperative

CONCLUSIONS

(1) The careful study and analysis of a series of acute ileus cases has been helpful in reducing their mortality percentage

(2) The factors chiefly responsible for the improvement seem to be

(*a*) Earlier operation, partly due to routine preoperative roentgenologic examination
(*b*) Better understanding of the problem to be solved
(*c*) More frequent use of spinal anesthesia
(*d*) Greater replacement of fluids and electrolytes
(*e*) More frequent use of peristaltic drugs and rectal treatments

(3) Continued improvement will probably depend largely upon earlier diagnosis

REFERENCE

[1] vanBeuren, F T, and Smith, B C Mortality in Acute Ileus, ANNALS OF SURGERY, 106 752–755 October, 1937

RÉSUMÉ BY DR BEVERLY C SMITH

(1) Mortality 66 6 per cent, 1916–1919 (acute ileus cases at Presbyterian Hospital) and 27 6 per cent, 1932–1935, 14 3 per cent in the acute mechanically obstructed group

(2) The advisability of two persons studying and classifying the charts of the cases included, to determine as closely as possible, from all available sources in the chart (a) The duration of the obstruction, (b) the type, *i e*, mechanical or paralytic—the degree of each if coexistent—and when the paralytic type became superimposed upon the mechanical, and (c) the degree of mechanical, *i e*, whether complete or incomplete

The charts, about which either Doctor vanBeuren or Doctor Smith was in doubt, were reviewed individually and together before the case was finally classified Record Room and discharge diagnoses were so frequently inadequate or incorrect that they could not be relied upon for statistical data The criteria for complete and incomplete mechanical and paralytic ileus as outlined in the paper were accepted because of their simplicity and recurrent accuracy

(3) 14 3 per cent mortality in 91 cases of complete obstruction is a surprising and unusual percentage

(4) It is important to contrast this with a mortality of 42 3 per cent resulting in 26 cases of incomplete obstruction The difficulty of diagnosing the incomplete, as compared to the complete variety is emphasized, with the delay in operating upon the incomplete cases because of uncertain diagnosis acting as the greatest contributory cause of the high mortality in this group

(5) The high incidence of postoperative adhesions—41 or 45 per cent of 91 cases of complete obstruction—strikingly illustrates the necessity of thoughtful peritonealization, gentle padding and handling of viscera, respect for the omentum, and serious consideration of the type and duration of drainage in each case

(6) In the incomplete group of 26 cases the highest mortality occurred in 12 cases of neoplasm of the intestine of which 10 were carcinomas of the colon The mortality of 58 3 per cent was caused by the high incidence of peritonitis following resection

(7) The paralytic cases were all associated with peritonitis and the mortality of 92 3 per cent is a striking warning as to the anticipation and

early treatment directed towards the prevention of this most serious complication

(8) The most treacherous and difficult type of case to diagnose was that due to recent postoperative adhesions associated with a peritonitis The possibility of obstruction in such cases should be borne in mind and every effort should be made to note its presence as early as possible

(9) We suggest for the consideration of future essayists on this subject that they consider similar criteria of classification, namely

(a) The percentage of late cases, *i e*, over 48 hours' duration,
(b) The cause or mechanism of the obstruction,
(c) The type—complete, incomplete, mechanical or paralytic

(10) As to diagnostic methods

(a) A careful history remains preeminent
(b) The roentgenologic examination has been most important and very reliable (92 per cent positive in 78 cases) It was correct in 96 per cent cases in which it was employed and which were operated upon It was not used in the more obvious type of cases such as strangulated herniae

The roentgenogram may be equivocable or negative—it is not infallibly correct, but when negative the operative indications again must revert to the history, physical signs and response to treatment

(11) Anesthesia —Spinal anesthesia seems to have proven most satisfactory in this group Yet there are definite contraindications to the use of it in certain types of cases and individuals Two cubic centimeters of pantocain in the second or third lumbar spaces was most frequently used A combination of spinal and some type of inhalation anesthesia gave the greatest percentage of postoperative respiratory and wound healing complications

(12) The Nasal Tube

(a) A few patients will not tolerate it
(b) Some patients vomit the tube repeatedly
(c) Ulceration in the esophagus has been noted at postmortem in some of the cases in which the tube was used
(d) One case with a deviated septum had an ulceration of the mucous membrane on the septum and an adhesion to the lateral nasal wall formed which nose and throat consultants thought could not be cured without a septal resection
(e) Cases of alkalosis from prolonged use of the tube have been reported—at the proper time it may be clamped off for periods
(f) It may relieve symptoms preoperatively temporarily, while a loop of gut with damaged blood supply remains in the abdomen

Preoperative gastric lavage is particularly indicated to deflate the stomach and prevent aspiration of vomitus during induction and recovery from anesthesia

Continuous preoperative nasal tube suction was most beneficial but it will not always empty the lower small intestine and if used for a prolonged period the plasma chlorids and CO_2 must be watched for possible alkalosis A 2 per cent cocaine spray to the nose and nasopharynx facilitates the passage of the tube with the minimum of gagging and strain on the abdominal wall wound A tube may be curled in the stomach and its open end be above the most dependent portion of the stomach Its position should be checked by a roentgenogram or the fluoroscope if it does not function The time to withdraw the tube can largely be determined by the character of the drainage material Its replacement should be constantly borne in mind

(13) Replacements of fluids and electrolytes The size and weight of the patient, the functional capacity of the myocardium and kidneys, the degree of shock, and the insensible fluid loss should be carefully estimated, and the plasma chlorides and serum protein and blood specific gravity should be followed to maintain a patient in water, electrolyte and protein equilibrium An average total parenteral intake of four to six liters of normal saline solution for a few days seems indicated in the average adult case

(14) The postoperative hypodermic administration of peristaltic drugs, such as pituitrin, prostigmine, pituitrin or peristaltine combined with the judicious employment of colon irrigations, lavages and enemata have, clinically, improved peristalsis, and their use should be persisted in until deflation and successful responses are consistently obtained

(15) The nasal tube seems to have replaced enterostomy in many of our cases Whereas this paper does not contain statistical data on enterostomies, we did note, in this series, that a primary enterostomy was more effective than a secondary one, and an ostomy in the more viable jejunum seems to function better than one in the more involved ileum The clinical and pathologic indications for enterostomy require astute judgment The relative ineffectiveness of enterostomy in paralytic ileus is stressed (a) The mortality following 42 enterostomies performed upon 39 cases out of 91 acute mechanical obstructions was 28 2 per cent (b) In 17 enterostomies performed upon the group of 26 cases of incomplete obstruction the mortality was 53 per cent (c) In ten enterostomies performed upon the group of 13 cases of paralytic ileus the mortality was 90 per cent

CASE REPORTS ILLUSTRATING ACUTE ILEUS

Presented by Dr Beverly C Smith

Case 1—W R, age 45 (1923), now 59 (U H No 57572), was admitted to Presbyterian Hospital July 23, 1923 complaining of having had attacks of cramping abdominal pains for the previous three years In 1917, he had been operated upon at the Polyclinic Hospital for a gastric ulcer Supposedly a gastro-enterostomy and an appendicectomy were performed He was well for three years thereafter, until 1920, when the present illness began, which has been characterized by sudden, severe attacks of upper abdominal cramp-like pain with vomiting He was admitted to, and remained in Mount Sinai Hospital for 11 days during this attack, which subsided under symptomatic treatment

Seven months later a similar episode occurred which gradually disappeared without treatment He vomited food eaten, then green fluid during this attack

The free interval between attacks had become shorter, but their severity did not increase until, on July 3, 1923, his pain became so severe that he fell, unconscious, in the street, and was taken to the Jamaica Hospital, and was discharged the following day He had another attack July 20, 1923, to control which morphine was administered This was followed three days later by a similar seizure which subsided spontaneously

Because the patient thought that food caused his attacks, he had not eaten for two days before admission to the Presbyterian Hospital, July 23, 1923 He had been on a modified diet without alkaline medications ever since his operation for gastric ulcer, although six months previously his ulcer had been pronounced healed which was confirmed by a gastro-intestinal roentgenologic series He had lost 28 pounds during the two months prior to admission, due to starvation

His family history was negative, and his past history revealed that he had suffered from indigestion since age 25

Physical Examination—Blood pressure 108/70 Weight loss evident The teeth were carious and pyorrhea was present Abdominal examination was negative except for a right rectus scar, without herniation Rectal examination was negative *Provisional Diagnosis*—Chronic ileus

Laboratory Data—Blood urea, July 25, 1933 0.34 Gm/l Wassermann Negative

	Free Hcl	Total Acid
Ewald test meal		
Fasting expression...	0	18
Expression 1 hr after meal	0	30
Expression 2½ hrs after meal	0	36

Red blood cells, 4,500,000, hemoglobin, 100 per cent, white blood cells, 6,800, polymorphonuclears, 54 per cent

Gastro-intestinal series, July 31, 1923, revealed a 15 per cent, six hour, gastric residue A gastro-enterostomy stoma was present, the barium passing both through it and through the pylorus In six hours the barium had reached the terminal ileum Two loops of ileum appeared dilated but the barium was not delayed in them In 24 hours, the ascending, transverse, descending colon and rectum were normally filled

After five days of hospitalization the patient was discharged to the Surgical Diagnostic Clinic for a further work-up Letters received from various doctors and hospitals confirmed the patient's story and diagnosis No mention of obstruction was made in any of them

At a three and six months follow-up, he had been continuously asymptomatic At 12 months, attacks had recurred Three followed in the next four months, characterized by sudden cramping pain just below the umbilicus and the vomiting of green fluid His physician, during each attack, gave him a hypodermic of morphine which allowed him to sleep and when he awakened the pain had gone

He was readmitted to Presbyterian Hospital, on August 28, 1925, complaining of a sudden, excruciating attack of crampy pain in his upper abdomen which had begun 16 hours previously Soon after its onset he vomited material eaten six hours before and had vomited greenish fluid repeatedly since The intensity of the crampy pains had diminished but they were still present intermittently He had had a normal stool the morning of admission which had no effect on his pain He was weak and prostrated For four days he had had an acute cold with a productive cough

Physical Examination showed a somewhat prostrated man with a pale, cold skin, bluish hands and dusky gray nail beds He vomited yellowish-brown fluid without fecaloid odor twice while being examined, and cried out and writhed when a spasm of pain would come on The lungs were normal Blood pressure, 146/20 The abdomen was scaphoid rather than distended There was no tenderness, spasticity or palpable mass He had had a stool as the result of an enema and had passed a considerable amount of

flatus with a colon lavage While being examined he had an attack of pain which made him cry out, and his upper right rectus became rigid, but as soon as the spasm subsided his abdomen immediately became soft again with no residual tenderness It was this attack of pain, and his history—not his physical signs—which made us urge the advisability of an immediate celiotomy

The operative findings were a surprise as compared to his preoperative signs and vividly emphasized the deceit and treachery of intestinal obstruction No scout roentgenograms were made Their proper interpretation would certainly have assisted greatly in the diagnosis

Operation—Under gas-oxygen anesthesia the abdomen was opened through an upper midline incision to the left of the right rectus scar The jejunum with a cherry-red-bluish color, distended to four or five centimeters, and filled the right abdomen and pelvis Seventy-five cubic centimeters of clear yellow peritoneal fluid was aspirated from the pelvis A segment of midjejunum was adherent to the site of the old scar for a distance of four centimeters This had acted as a fulcrum point about which the proximal jejunum had volvulated and descended into the pelvis The distension was due mostly to fluid in the bowel and not to gas The fluid made the loops so heavy that as one was drawn out of the cavity the weight of the fluid in it pulled more gut out, tending to eviscerate the patient An enterostomy was done and a fenestrated No 16 F catheter was introduced near the end of the volvulated jejunum in nearly normal appearing gut The end of the catheter was brought out through a small stab wound This did not drain the gut A second enterostomy, therefore, was made higher up in the distended jejunum and 500 cc of foul, brown fluid drained immediately This permitted further exploration without evisceration, which revealed a collapsed stomach, colon and ileum, and no evidence of peritonitis or other adhesions The adherent knuckle of gut was freed and peritonealized The wound was closed in layers with chromic catgut An infusion of a liter of normal saline and 500 cc of 5 per cent glucose was introduced during the operation Two rubber dam drains were placed in the subcutaneous wound because of possible contamination from an enterostomy tube

Convalescence was relatively uneventful except for a wound infection which necessitated opening the skin incision, and resulted in a slough of some of the midline aponeurosis, evisceration did not occur, however, notwithstanding an exacerbation of his cough and bronchitis

The lower jejunostomy tube was removed on the eighth day No drainage followed and it remained healed The upper jejunostomy tube was removed on the twelfth day and it too healed without subsequent drainage

The appended tabulation shows an interesting comparison of the amount of drainage recovered from these tubes

	1st 6 hrs	1st day	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Upper tube	605 cc	110	170	60	10	20	120	125	250	350	200
Lower tube	50 cc	260	380	1,040	1,560	430	410	200	60		

Postoperative treatment consisted of 2,500 to 4,000 cc of normal saline daily, continuous abdominal poultices, colon irrigations for two days, then enemata Peristaltin was given twice on the third and fourth days, and rectal treatments were effective On the twelfth postoperative day the patient vomited 800 cc of yellow fluid, and on the fourteenth, eighteenth and twenty-first postoperative days 100 cc of similar material During this time rectal treatments were effectual and he did not become distended He was discharged 29 days after operation

Follow-up at two months Rating 444*

Follow-up at one year He had had four attacks of abdominal cramps with vomiting

* Anatomic 4 = 100%, symptomatic 4 = 100%, economic 4 = 100%

Passing flatus and vomiting had relieved his pain He had lost 19 pounds in weight and did not eat because he felt better when his stomach was empty

In March, 1926, he was admitted the third time complaining of attacks of crampy pain and vomiting for the past two weeks Pain began in the right flank and radiated into the epigastrium Previous to this he had been symptom-free The vomiting consisted of food eaten, followed by green fluid It relieved his cramps and some days he vomited as frequently as seven times His bowels had moved without catharsis up to the last week Since then daily enemata have been necessary

Physical Examination shows loss of weight Foul breath odor Abdomen flat, no distention Two operative scars in upper abdomen No tenderness, mass, visible peristalsis, or palpable viscera

Laboratory Data Blood pressure, 120/80, white blood cells, 11,400, polymorphonuclears, 63 per cent Gastric lavage, clear odorless green fluid Blood urea, 14 2 mg Plasma chlorides, 5 45 Gm CO_2 51 Ml Urine, negative

Ewald meal

Fasting	No free Hcl	
1 hr after meal	free 11	Total 45
2 hrs after meal	free 0	Total 30

He remained in the hospital six days His signs and symptoms disappeared with gastric lavages and small fluid feedings

Follow-Up—One year after operation Gained 14 pounds Doing full days' work as a truck driver Rating 444 Two years after operation Has had three attacks of abdominal pain Vomited green fluid several times with each attack These attacks caused him to lose jobs as each incapacitated him for two to three days Three years after operation He has had one severe, similar attack which lasted 36 hours He vomited six times with it Cramps gradually subsided after a stool Four years after operation No attack for six months Rating 444 He has developed a postoperative, medial, ventral wound hernia resembling a diastasis It is symptomless and not enlarging Five years after operation Rating 444

Eleven and one-half years after operation Has been perfectly well until two months ago when he noted dizziness, weakness, nausea and vomiting He has lost 18 pounds in past year When he has abdominal pain he can occasionally feel a lump in the left upper abdomen

Fasting gastric expression showed no free HCl After an Ewald meal the free HCl was six and the total acid 16 The fasting expression of 100 cc was a foul smelling, yellow, mucoid fluid

October 9, 1937—Fluoroscopy of his stomach showed a functioning gastro-enterostomy stoma and pylorus, without evidence of ulcer at either site Barium passed through the small intestine without obstruction and reached the cecum in nine hours, slightly, but not appreciably delayed The colon was normal There was no roentgenologic evidence at this time of partial obstruction Segmented distribution of the barium in his gastrointestinal series possibly indicates some degree of vitamin deficiency

COMMENT—This patient is presented as a case of recurrent, partial intestinal obstruction due to postoperative adherence of the gut to the wound site It illustrates the value of the history in these cases and the difficulty in correlating the pathology in the gut with the physical signs This patient had been seen by a number of doctors and had been in several hospitals He had refused operation because he had recovered so rapidly from his attacks It seems advisable to keep the cases under frequent observation during his attacks, and with the employment of roentgenologic examinations it may be easier to determine whether the pains are due to peristalsis and obstructed

bowel, or to peristalsis associated with peritoneal adhesions without obstruction As will be seen in the statistical resume, this type of case gives a higher percentage of mortality

Case 2—(U H No 520466) B G, female, age 64, was admitted to Presbyterian Hospital June 4, 1937, complaining of vomiting, upper abdominal pain, and obstipation of four days' duration She had been operated upon by Dr John B Murphy at the Haneman Hospital in Chicago 40 years previously for the removal of a pelvic tumor, the nature of which she did not know She had had typhoid fever in 1930, from which she recovered without complications One week before admission she had an acute onset of pain in her right upper abdomen and flank which was followed by a chill A saline cathartic and a hot water bottle applied locally gave her relief, and the next day she was free of pain

Five days before admission she noted abdominal fullness associated with eructations, gas and obstipation, followed two days later by nausea and vomiting of first, mucoid, then green fluid The vomiting usually occurred in the evenings and she was able to take and retain some food in the morning She had had two stools in the five days before admission and had not taken any cathartic Cramping pains originating in her right abdomen and radiating to her right back and shoulder had persisted for five days before admission

At no time did this patient consider herself sufficiently ill to call a doctor For years she had noticed an intolerance to fatty foods, constipation and bloating During the past 15 weeks she had lost 15 lbs, primarily because of dieting in order to relieve her gastric distress

Six weeks previous to admission her physician had diagnosed her case as one of hypertensive disease because of dyspnea on exertion and had given her digitalis She had no history of cardiac decompensation Her other systems were negative except that she had had a short period of unconsciousness nine weeks previous to admission, without paralysis or other sequelae On admission she was slightly dyspneic but in no apparent acute distress

Physical Examination—Enlarged heart with extra systoles apical systolic murmur with loud second aortic sound Abdomen slightly distended with moderate tenderness in the right upper quadrant, most marked below the costal margin over the gallbladder region No masses could be felt A lower abdominal, midline scar was firm without evidence of hernia Rectal and pelvic examinations were negative A diagnosis of an acute exacerbation of a chronic cholecystitis had been made on admission

Roentgenologic examination, June 4, 1937 (No 159879), of the abdomen in three positions did not show dilated loops or fluid levels

Laboratory Data—Blood sugar and urea nitrogen, June 5, 1937, normal EKG, June 5, 1937 Slight evidence of myocardial damage Wassermann, negative

June 7, 1937 Cholecystogram showed a faint gallbladder shadow without evidence of calculi There was no diminution of the shadow following a fatty meal This was considered contributory evidence of gallbladder disease

June 8, 1937 Barium enema showed a normal large bowel A long, slender appendix was seen in the right iliac fossa

June 9, 1937 Duodenal drainage, after two stimulations by 50 cc of 50 per cent magnesium sulphate solution, revealed no B bile and no cholesterol crystals or bilirubin pigment

June 10, 1937 A second biliary drainage produced B bile which again failed to show cholesterol crystals or bilirubin pigment, but contained a moderate number of bile stained leukocytes

June 17, 1937 A study of the small intestine showed a marked delay in the emptying of the stomach which contained a little barium up to the 48 hour period There was also delay in the emptying of the second and third portions of the duodenum which appeared moderately dilated This study was not diagnostic of definite pathology in the

small intestine The roentgenologist stated, however, that such abnormal gastric and duodenal pathology could occur as a result of an acute cholecystitis

June 14, 1937 Stool examination was negative for typhoid or dysentery organisms

An attempt, June 21, 1937, to pass a tube into the duodenum was unsuccessful About 50 cc of barium were injected through it, however, into the stomach This material passed readily through the pylorus into the duodenum and jejunum without delay, demonstrating the absence of obstruction in the third portion of the duodenum

June 11, 1937 Gastro-intestinal series revealed a flattened superior surface of the duodenal bulb which was suggestive of periduodenal adhesions due to chronic cholecystitis There was tenderness during this examination in the right upper quadrant and over the region of the gallbladder No organic disease could be demonstrated in either the stomach or duodenum

June 15, 1937 At 7 45 P M the patient vomited 900 cc of cloudy material, at 3 45 A M she vomited 800 cc more, and at 11 30 A M, on June 16, 1,000 cc of dark green fluid containing particles of undigested food

A three position roentgenogram, at 10 30 A M, June 16, failed to reveal evidence of acute intestinal obstruction Her abdomen was soft, with slight, vague, indefinite tenderness in the upper portion of the right lower quadrant There was no tenderness over the gallbladder region or in the right costovertebral angle

A small suction tube was passed into the stomach through the nose and continuous suction was started She was given a clysis of 1,500 cc of Ringer's solution, and water by mouth was limited to not more than 30 cc an hour The tube was ejected repeatedly and had to be discontinued In 24 hours, from 6/15/37 to 6/16/37 she vomited 2,200 cc of olive-green fluid and 300 cc had been obtained by the continuous suction tube

Her temperature ranged between 99° to 100° F Pulse varied from 60 to 80 Blood pressure remained at 150/100 The patient stated that she felt perfectly well, and at no time did she appear acutely ill During this 48 hour period she had received 5,300 cc of fluid, practically all of which was Ringer's solution and her output had been satisfactory Urine was negative White blood cells, 12,700, polymorphonuclears, 78 per cent It was noteworthy that at no time did her abdomen show spasm, distention, palpable mass or viscera, and only very slight tenderness, from time to time Her signs were essentially fleeting and inconclusive Her sense of well-being and desire for food was of note

At this time, in spite of the opinion of most of the surgical staff that she had a chronic gallbladder, it was felt that she had a partial, intermittent small intestine obstruction which the roentgenograms had failed to reveal This attack subsided after three days The leukocyte count had returned to normal by the nineteenth day and nasal gastric tube, which had been in place 72 hours, was draining clear bile and was removed She had normal bowel movements with daily enemata during the attack She improved steadily thereafter, but because of our inability to make a definite diagnosis it was thought justifiable to explore her abdomen

Operation—June 28, 1937 Avertin, gas-oxygen anesthesia The gallbladder was found to be small, normal in color and without adhesions, it was not thickened, was easily emptied by digital pressure and contained no stones The stomach, duodenum and pancreas were normal The common duct felt normal The omentum was densely adherent to the old, lower midline scar and a loop of ileum was attached to the lower end of the scar in a S formation The adhesions between the antimesenteric border of the ileum and anterior abdominal wall had become stretched, to producing effect of a mesentery on the antimesenteric border The site of the attached ileal loop was eight centimeters long The ileum going up to and leaving the loop was sharply angulated at each end and was evidently the site of a partial recurring obstruction The uterus, both tubes and ovaries were atrophic but normal The appendix was normal

The abdomen had been opened through a paracostal, right upper quadrant incision and upon finding no pathology in the biliary tract, a second midline incision, excising the old lower abdominal incision, was made and the ileum freed from the scar The denuded surface of the ileum was peritonealized and both wounds closed in layers with silk

The patient withstood the operative procedure very well and had an uncomplicated recovery, being discharged on the eighteenth day following operation

Follow-Up—Three months following operation, she stated that she felt well in every way She had had no abdominal symptoms and a tablespoonful of mineral oil every morning effected a daily stool, which she had not had for ten years She is free of all her preoperative symptoms, the wounds are firm, she has an excellent appetite and she has gained weight

COMMENT—This case is shown as an example of one of partial, recurrent intestinal obstruction due to postoperative peritoneal adhesions The symptoms and signs at the time of admission, during an acute obstructive attack, were indefinite and confusing, simulating an acute exacerbation of a chronic cholecystitis, in a patient who had had typhoid fever seven years previously She was seen by a number of the staff to whom the diagnosis was not clear and who even had doubts of the existence of the true pathology when seen during an acute attack of nausea, vomiting, abdominal pain and soft distention

The three position roentgenograms, G I series, small intestine study, and barium enemata did not definitely show the true pathology The fact that one duodenal drainage failed to show B bile, and a cholecystogram showed only a faint shadow with no emptying, confused the diagnosis This type of case is dangerous because the diagnosis is difficult, however, in the presence of such symptoms, regardless of the laboratory data or physical examination findings, one must certainly consider the possibility of some degree of intestinal obstruction in view of the presence of an abdominal scar

DISCUSSION—DR SEWARD ERDMAN (New York) remarked upon the marked reduction of mortality in the last four-year period The several reports from the Presbyterian Hospital by Doctor vanBeuren now cover a period of several decades and constitute a very large and valuable series for analysis and comparison

There is still lacking in medical literature any unanimity in the use of the adjectives applied to the word "ileus," such as dynamic, adynamic, postoperative, mechanical and paralytic, therefore, the simplicity of Doctor vanBeuren's two classifications, *i e*, (1) mechanical and (2) paralytic, is appreciated

His personal belief was that the primary absence or presence of peritonitis was the chief difference between mechanical and paralytic ileus (which latter he prefers to call "peritonitic ileus") Certainly all the enumerated types of mechanical ileus due to neoplasms, old adhesions and bands, strangulated herniae, gallstones, intussusception, volvulus, the obstruction, and some cases of wound disruption, occur, primarily, in a clean, noninfected abdomen, which as a result of delay in operating may become infected

On the other hand in paralytic or "peritonitic ileus," some grade of peritonitis or at least some serious insult to the peritoneum by operation, precedes the obstructive symptoms (The entire list of paralytic ileus cases in vanBeuren's series all had peritonitis) But, almost universally, the "peritonitic ileus" soon develops a mechanical obstruction due to adherent loops and kinks, though it should still be classed as "peritonitic"

Some writers dignify the common 48 hour postoperative distention, pain, vomiting, and temporary paresis as postoperative paralytic *ileus*!—but certainly such cases when they yield to hot formentations, enemata, pitressin, and

stomach drainage, seldom deserve a classification as intestinal obstruction, or ileus

Approaching ileus from the surgical standpoint, however, it will *be agreed* that, in all forms of mechanical obstruction, operation of one type or another is absolutely essential, and that lowered mortality will depend upon the promptness of surgical intervention, and the ability to deal with the underlying pathology Of course, preliminary treatment to restore the body fluids and altered chemistry are essential

Doctor vanBeuren states "That in order to compare fairly the results in one series of ileus cases with another, each series must first be analyzed in three ways, (a) according to percentage of late cases, (b) according to cause or mechanism, (c) according to type—complete or incomplete, mechanical or paralytic"

He agreed absolutely with this statement and wished that all the carcinoma cases had been put into a separate classification because the mortality in such cases is much more dependent upon the underlying cancer than upon method of treatment

Therefore, Doctor vanBeuren's Table IV showing the mortality of enterostomy in 39 patients, including a large number of colostomies for cancer, serves only to confuse the surgeon who would like to evaluate the results of enterostomies (of the small intestine) performed for the relief of acute ileus not complicated by cancer

His interest in enterostomy for postoperative paralytic or "peritonitic ileus" began some 18 years ago and he had reported the earlier cases in the Surgical Clinics of North America in 1921, from the Second Surgical Division of the New York Hospital In the next ten years, upwards of 70 high enterostomies were performed by members of that Staff for "peritonitic ileus" only too often without benefit, and sometimes without the best surgical judgment Some six years ago, before the New York Surgical Society, he alluded to these cases and the late Dr Frank S Matthews, whose opinion he always regarded so highly, very properly criticized such indiscriminate use of enterostomy He still believes, however, that enterostomy is a life saving measure in selected cases of postoperative "peritonitic ileus," but it is not easy to clearly define the indications in a given case or to select the most propitious time for employing this measure

In the paralytic ileus resulting from a fulminating general peritonitis, it is of no advantage to perform an enterostomy, for it will not continue to drain However, it is well recognized that a mechanical obstruction very often develops due to the matting together of intestinal loops by the peritonitis, and may prove to be the cause of death It is in cases of "peritonitic ileus," with a mechanical obstruction added, that the brilliant results of a timely enterostomy are best demonstrated

Mechanical obstruction following appendicitis requires some days to develop, probably from five to seven days, after the onset of the appendicitis, which, however, may mean at or soon after operation, in late operative cases

"Peritonitic ileus" following appendicitis is so common, and the underlying pathology so nearly parallel in all cases, that a study of the results of enterostomy in this one disease would be most enlightening and perhaps in the future reports Doctor vanBeuren will segregate these cases In the group of "Appendicitis with Fibrino-Purulent Peritonitis," Krech found the mortality ran between 57 and 93 per cent, and Dudley's statistics indicate an 83 per cent mortality, he also states that one-quarter of these die from mechanical obstruction He believes that his own experience in 36 cases of enterostomy for "peritonitic ileus" after appendicitis, although showing a mortality over 50 per cent, nevertheless resulted in considerable saving of life

ACUTE INTESTINAL OBSTRUCTION

A STATISTICAL SURVEY OF THREE HUNDRED FORTY-TWO CASES

T TODYO, M D

KOGOSHIMA, JAPAN

IN VIEW of the varying incidence of acute intestinal obstructions, especially of certain types of them, in different countries, a review on the occurrence of this condition in Japan might be of interest The material which is considered deals with 342 consecutive cases operated upon by the author, between May, 1920, and July, 1935, in Kagoshima, situated in the farthest, southwestern part of Japan proper

The cases are classified as follows

(1) Intussusception
(2) Volvulus
(3) Strangulation by bands
(4) Ileus by adhesion
(5) Ileus caused by Meckel's diverticulum
(6) Ileus due to internal hernia
(7) Arterioduodenal ileus
(8) Ileus by foreign bodies
(9) Ileus by tumor
(10) Compression ileus
(11) Congenital intestinal obstruction
(12) Spastic ileus
(13) Ileus of unknown etiology

Those cases which recovered after establishing a Witzel's fistula, which needed no further operation, or those which died after such an operation without improving, are classified as "ileus of unknown etiology"

Intussusception—There were 154 cases with an operative mortality of 24 per cent Intussusception is very common among the Anglo-Saxons Although in Germany this is considered rare, according to the report by Ravens[24] of Kiel Clinic (Prof Anschutz), intussusception proved to be the etiologic factor in 19 per cent in his 439 ileus cases (83 cases)

In Japan the statistics show 15 to 26 per cent of the whole number of cases of ileus to be caused by intussusception Of the 342 cases upon which I have operated, 154 cases were found to be caused by intussusception (45 per cent) The frequency of occurrence of this condition in my series and that of the occurrence of volvulus in Russia, give practically the percentage, as in Russia intestinal obstructions are due to volvulus in almost 50 per cent of the cases

It may be pointed out from my experiences that in Japan proper, intus-

Submitted for publication October 15, 1936

susceptions are very frequently encountered in the southwestern part of the country

I am in accord with the opinion of many authors that the lack of fixity of the ascending colon to the posterior abdominal wall is a significant factor in the formation and development of intussusception My opinion is based on the fact that in 38 of the 154 cases of intussusception, the ascending colon was found to lack its normal fusion to the posterior abdominal wall in its entire length, and in 39 cases, in its upper one-third or two-thirds

In all statistics on intussusception the males have always predominated, and of my 154 cases, 108, or 70 per cent, were males, and 46, or 30 per cent, were females

The relative frequency with respect to age was as follows (Table I)

TABLE I

AGE INCIDENCE

Age	Number of Cases	Percentage
0 up to 1 yr	46	29 9
2 to 3 yrs	23	14 9
4 to 10 yrs	31	20 1
11 to 20 yrs	13	8 4
21 to 30 yrs	7	4 5
31 to 40 yrs	14	9 1
41 to 50 yrs	12	7 8
over 51 yrs	8	5 2
Total	154	

In the present series, the youngest was a male, 30 days old, and the oldest was a male, age 67, both patients were cured by the operation

The Starting Point of Intussusception varied as follows (Table II)

TABLE II

THE STARTING POINT OF INTUSSUSCEPTION

Starting Point	Cases	Percentage
Cecum	98	63 6
Lower portion of the ileum	49	31 7
Transverse colon	2	1 3
Ascending colon	1	0 7
Small intestine	4	2 6
Total	154	

Retrograde Intussusceptions have occurred in three instances One of these was particularly remarkable, being retrograde, multiple, superimposed, and recurrent

Case Report—A male, age 20, was operated upon for an incarcerated inguinal hernia of the left side, August 23, 1925, 12 hours after the onset of the symptoms As the incarcerated portion of the intestine was gangrenous, it was necessary to perform

a resection of that segment The incarceration occurred 121 cm above the ileocecal valve Between the situation of the incarceration and the duodenojejunal flexure the intestine showed intussusceptions at ten different places, the uppermost one being situated 10 cm below the duodenojejunal flexure The distances between each distal intussusception were recorded as follows Distances from the duodenojejunal flexure were, 10, 7, 35, 58, 42, 125, 48, 30, 32, and 27 cm (Fig 1)

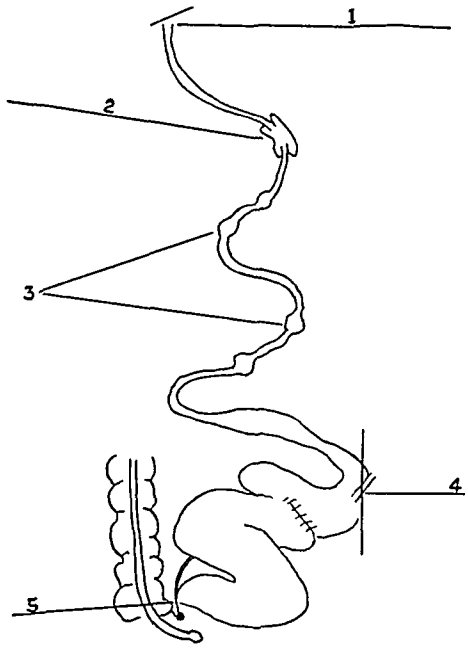


Fig 1 —Showing the sites of multiple, retrograde and recurrent intussusceptions (1) Duodenojejunal flexure (2) Retrograde and downward invagination (3) Invaginations at an early stage of their development (4) Oblique fistula (5) Obstruction from a band

Most of these intussusceptions were retrograde and some of them were superimposed They were reduced without difficulty, and the patient was discharged 16 days postoperative

Recurrence—Forty days after the first operation, October 1, 1925, at 10 A M, the patient was suddenly seized with severe pain in the abdomen and four hours later a celiotomy was performed The lower end of the ileum was found to be strangulated by a band and the intestinal wall of that portion was discolored By removal of the band the intestinal passage was restored and the normal color of the intestine returned At this time, multiple intussusceptions were again found in different portions of the small intestine, the uppermost one, 155 cm below the duodenojejunal flexure, showing a retrograde, and usual (downward), intussusception at the same time Four others were found in a very early stage of development of an invagination, each showing a ring-like fold of the intestinal wall (Fig 1) They were all reduced

Superimposed Intussusceptions are not common, six instances of them have been encountered

Multiple Intussusceptions were found in the one case described above

Symptoms of Intussusception showed the following frequence of appearance (Table III)

Table III

Relative Frequency of Appearance of Symptoms

Symptom	Percentage
Pain	91
Tumor	75
Vomiting	64
Passing of blood per rectum	60
Distention	34
Increased peristalsis	32

In four instances in this series the reduction took place spontaneously on the operating table before beginning the abdominal section The children screamed and struggled desperately against the anesthetic and their very action evidently contributed to their recovery In one of these cases the abdomen

was opened after the spontaneous reduction had apparently occurred, to ascertain whether the intussusception was completely disinvaginated or not The celiotomy revealed only a small, hard, cup-shaped depression at the caput cecı

Operative Mortality—The shorter the interval between the onset of symptoms and operation, the lower the mortality will be The operative mortality in this series was 24 per cent (Table IV)

TABLE IV

ANALYSIS OF AGE INCIDENCE AND OPERATIVE MORTALITY

Age	Cases	Cured	Died	Oper Mortality Percentage
0 up to 1 yr	46	34	12	26 0
2 to 3 yrs	23	21	2	8 7
4 to 10 yrs	31	25	6	19 3
11 to 20 yrs	13	11	2	15 4
21 to 30 yrs	7	5	2	28 6
31 to 40 yrs	14	10	4	28 6
41 to 50 yrs	12	7	5	41 7
over 51 yrs	8	4	4	50 0

Anschutz warned against the opinion expressed by Perthes,[23] that the treatment of invagination should be conservative up to the age of one and one-half years, and urged the immediate surgical treatment in cases of acute invagination occurring in early childhood Personally, I have not noted any particular danger in operating upon cases occurring in early childhood, on the other hand, the operative mortality, in my series, was much higher in the patients of advanced age (Table IV)

Resection—According to Clubbe,[8] one must expect to find the bowel gangrenous or irreducible in about 6 per cent of the cases operated upon for intussusception, and in these cases one must employ resection The mortality of various authors who have used this procedure has, so far, been very high Of 154 cases upon which I have operated, resection had to be resorted to in 19 instances and six of them recovered In my resection cases all of the successful results were obtained in patients more than five years of age

Recurrence—Clubbe experienced recurrence in two instances of his 253 intussusceptions, and in Close's[6] series (363 cases) intussusception occurred twice in 14 instances, and occurred three times in two cases In my series intussusception occurred twice in three instances, and in one it occurred five times

Prevention of Recurrence—Clubbe warned against the procedure of anchoring the cecum as a means of lowering the mortality To prevent the recurrence I have (when the condition of the patient permitted) fixed the cecum and ascending colon to the peritoneum of the right iliac fossa in 26 cases, after completion of the reduction Of these 26 cases four died

Volvulus—Twenty-two cases, operative mortality, 27 3 per cent To determine the frequency of volvulus in different countries, a survey was made by Muzeniek,[19] according to which, of the total ileus cases, volvulus was the

etiologic factor in 13 per cent in Germany, 16 per cent in France, and 12 per cent in America Volvulus predominates in the acute intestinal obstructions of Russia In Japan the statistics, by various authors on this subject, show variations of from 9 to 25 per cent In my series volvulus constituted about 6 per cent of all ileus cases

While in Europe males are more subject to volvulus than females, in Japan authors report that a majority of such cases are found in females In my series, however, males predominated, the proportion being 13 to 9

The sigmoid flexure is most frequently involved, the undue length of the bowel in this part being considered as a causative factor

The sites of the volvulus in my series are as follows (Table V)

TABLE V

SITES OF VOLVULUS

Sigmoid flexure	14
Lower part of ileum	3
Small intestine	4
Ascending colon	1

Strangulation by Band—Fifty cases, operative mortality 22 per cent

Ileus by Adhesion—Sixty-seven cases, operative mortality 31 per cent In strangulation and ileus by adhesion in my series, appendicitis, past or present (37 cases), previous celiotomy (12 cases), and tubercular peritonitis (16 cases) were frequently found as the etiologic factor

Ileus Caused by Meckel's Diverticulum—Five cases, operative mortality, 60 per cent

Ileus Due to Internal Hernia—Four cases, operative mortality, 50 per cent Of the four cases, one due to transmesocolic hernia, without sac proper, interested me as it is apparently very rare

Case Report—A male, age 74, was first seen July 4, 1926 There had been a bowel movement the previous day at 11 A M Thirty minutes later the patient complained of slight pain in the upper abdomen It increased in intensity, and he vomited repeatedly There was no flatus nor defecation after the onset of the pain A prominent tumor-like, circumscribed distention was noted in the upper abdomen The other part of the abdomen was comparatively retracted The patient was operated upon at 5 P M, July 4, 1926 There was some blood-stained fluid in the abdominal cavity A coil of small intestine, 39 cm long, was festooned in the shape of a horse-shoe over the anterior wall of the stomach, through the openings in the mesocolon and the small omentum The construction of the bowel at the opening in the mesocolon caused the acute intestinal obstruction The ensnared coil was distended and slightly discolored The upper end of the involved intestine was found 31 cm below the duodenojejunal flexure The stomach was slightly distended After reduction the abnormal openings were closed by sutures Recovery was uneventful (Fig 2)

Arterio-duodenal Ileus—Three cases, operative mortality, 66 7 per cent In all three instances the small intestines had dropped down into the pelvis, stretching the superior mesenteric artery and vein, so that they compressed the duodenum and obstructed it As the intestines were lifted up, the pressure on the duodenum was relieved and the lumen of the obstructed gut was re-

stored, but on allowing them to drop free the compression again occurred A gastro-enterostomy was, therefore, performed in each instance

Ileus by Foreign Bodies—Eight cases, operative mortality, 60 per cent (Ascaris, four cases, inspissated feces, one case, others, three cases)

Ileus by Tumor—Six cases, operative mortality, 66 7 per cent

Compression Ileus—Three cases, operative mortality, 33 per cent

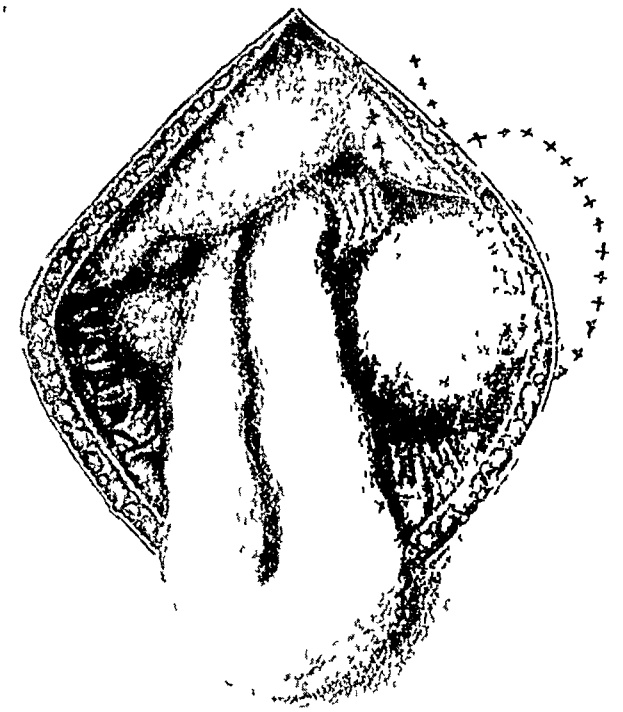


FIG 2—Showing the appearance of the strangulated loop of intestine in the case of transmesocolic hernia

Congenital Intestinal Obstruction—One case, operative mortality, 100 per cent

Case Report—Male, age three days Soon after birth the baby began to vomit frequently A rectal irrigation resulted in the passage of some mucus When first seen, December 15, 1927, the abdomen was extremely distended and showed increased peristalsis The baby looked very anxious and screamed at short intervals Upon operating, a small amount of fluid was found in the abdominal cavity The first obstruction was found 93 cm below the duodenojejunal flexure, and the second, 10 cm below the first, both were due to a congenital anomaly The stomach and intestines, down to the first obstruction, were extremely distended An oblique fistula was made above the first obstruction, in order to relieve the distention, and for the second, an enterostomy was performed Death ensued 12 hours postoperative

Spastic Ileus—One case, operative mortality, zero

Symptoms—The frequency of appearance of symptoms in the present series is as follows (except intussusception) (Table VI)

Operative Mortality—In spite of the progress of surgery in the last few decades the operative mortality of acute intestinal obstruction is still too high The mortality percentage depends upon the time elapsed and the ability of

TABLE VI

FREQUENCY OF APPEARANCE OF SYMPTOMS

Pain in the abdomen	93%
Vomiting	78%
Constipation	70%
Distention	65%
Increased peristalsis	65%
Rumble	51%

the surgeon, that is, the shorter the time between the onset of the symptoms and the beginning of the surgical procedure, the lower will be the mortality rate Of 342 cases operated upon, the mortality was 32 per cent If the intussusceptions are excluded, the mortality of the remaining 188 cases rises to 38 8 per cent

Results of Operating at Various Stages—The idea expressed in the last paragraph can perhaps be better shown, and its importance more clearly grasped, from Table VII (intussusceptions excluded)

TABLE VII

MORTALITY RESULTING FROM OPERATING AT VARIOUS STAGES

Interval between the Onset of Symptoms and the Operation	Cases	Died	Operative Mortality Percentage
Up to 12 hrs	21	5	23 8
13 to 24 hrs	29	9	31 0
25 to 48 hrs	48	15	31 0
Over 49 hrs	90	44	49 0

Treatment—The general consensus of opinion of many surgeons is that the surgical procedure applied to acute intestinal obstruction must be minimized, for one must bear in mind the impoverished resistance of these patients to surgical interference In the presence of marked distention it is impossible to definitely disclose the pathologic conditions within the abdomen If one operates upon such a case radically, in one stage, there is great danger of damaging the friable intestinal wall and contaminating the abdominal cavity with the intestinal contents

When circumstances do not permit the radical operation, an oblique fecal fistula has been placed in the most distended coil, and a small rubber tube introduced into the gut through a small incision I strongly warn against the formation of a simple fecal fistula, because the subsequent treatment for the fistula is an annoying one The oblique fistula never produces a permanent artificial anus Later, when the distention has been reduced by drainage through the fistula and the critical period has been passed, the abdomen should be widely opened, and the cause of the obstruction removed Fortunately, the most distended portion of the coil, where the oblique fistula was formed, is always found to be just above the obstruction It may be considered an excellent indication, if the intestinal content begins to drain

through it at the moment, or soon after its formation This drainage through the fistula does not begin, unless the peristaltic movement of the bowel is restored It is not rare that flatus and feces per rectum will be evacuated without further operation after the formation of the fistula If the bowel begins to move normally, the drainage through the fistula stops spontaneously The rubber tube is then removed and the fistula heals spontaneously

An oblique fistula was effected in 72 instances, and 40 patients were saved by this procedure (operative mortality, 44 per cent) This mortality rate may appear too high, but it must be taken into consideration that this procedure was used more especially in very serious cases, where the surgical risk with more complicated manipulations would have been correspondingly greater

In the present series there are 15 instances where, after the formation of the fistula, no further operation was necessary In 27 cases subsequent operations were needed The average interval between the formation of the fistula and the subsequent operation was 17 days

Ileus Caused by the Oblique Fistula.—There were five cases of acute intestinal obstruction caused by the kinking of the coil at the point where the oblique fistula had been previously formed However, it is relatively an easy matter to release the kink by operation and no deaths resulted from the condition

Operative Closure of the Transverse Fecal Fistula in the Early Stage.—In some cases of acute intestinal obstruction due to strangulation, especially from volvulus, the blood circulation of the mesentery is so greatly interfered with that the bowel becomes gangrenous in a remarkably short time The patient collapses and suffers profoundly from toxemia Upon opening the abdomen, blood-stained fluid escapes and the gangrenous loop, a foul-smelling and discolored mass, is found In such circumstances the surgeon must attempt to save the patient by the simplest and speediest procedure possible, namely, that of drawing out the gangrenous loop and resecting it However, difficulties follow the employment of this procedure, because dehydration, irritation and soiling of the surrounding skin by discharge from the fecal fistula, and inanition, when the fistula is formed high in the small intestine, cannot be avoided As a rule it requires a long time to perform the second operation for the closure of the fistula, as the chances of recovery depend largely upon the condition of the affected skin surrounding the fistula

For shortening the time between the formation of the fistula and the second operation, a consideration of Tschmarke's[27] technic will be found helpful I have operated twice in the following manner

After resection of the gangrenous loop, rubber tubes, 25 cm long, are put into each of the cut ends of the bowel, and held in place by tying a string around the outside of the bowel The two cut ends of the bowel are thus brought out through the incision, side by side, and their serous surfaces are sutured to the parietal wound, allowing about 2 cm of each cut end to project beyond the surface of the skin The two ends of the bowel outside the peritoneal cavity are surrounded with gauze During the next few days the content of the

bowel drains through the rubber tube without soiling the wound or skin, since the two external ends of the tubes are deflected to the side of the abdomen

The second operation is very simple By removing the sutures, the abdomen is reopened, and the two ends of the bowel, which have been kept outside, are resected and united end-to-end The second operation must be performed as soon as possible, as the bowel bound to the rubber tube soon becomes gangrenous and leakage of the bowel content occurs

ILLUSTRATIVE CASE REPORTS

Case 1—Volvulus of the Small Intestine Male, age 31 At the first operation 240 cm of the involved gangrenous loop were resected and treated by the above mentioned procedure The second operation for the closure of the fecal fistula was undertaken three days later Since the third day after the second operation, the bowel has moved normally, and the result of the operation itself was excellent But, unfortunately, the patient succumbed as the result of cerebral embolism

Case 2—Volvulus of the Ascending Colon and the Lower End of the Ileum Female, age 42 At the first operation the gangrenous loop was resected and treated as above mentioned The second operation for the closure of the fecal fistula was undertaken two days later Normal bowel movement followed the second operation, and the patient was enjoying an uncomplicated convalescence, when she contracted acute pneumonia, from which she died seven days after the second operation

SUMMARY AND CONCLUSIONS

(1) A statistical survey of 342 cases of acute intestinal obstruction operated upon during the last 15 years and 3 months is made

(2) Intussusceptions constituted 45 per cent of all ileus cases

(3) The partial or total lack of fixity of the ascending colon to the posterior abdominal wall is considered as a significant factor in the formation and development of intussusception Of the 154 cases of intussusception, it was found that in 38 cases the ascending colon lacked its normal fusion to the posterior abdominal wall in its entire length, and in 39 cases in its upper first or second third

(4) The average operative mortality of all of the series was 32 per cent, in the cases of intussusception exclusively, it was 24 per cent

(5) Although it is generally believed that the operative mortality following intussusception is very high in children under the age of one year, it is not true in the writer's case, on the other hand, the operative result is much more markedly unfortunate in the patients over 40 years of age

(6) The factors which may reduce the operative mortality, are early diagnosis and immediate surgical interference in the earliest stage of the disease

(7) In serious cases of acute intestinal obstruction, surgical procedures must be reduced to the minimum For this reason the writer has frequently employed that of effecting an oblique fistula The simple, direct intestinal fistula results in a permanent fecal fistula This complication can be prevented by the formation of an oblique fistula, using a thin rubber tube

(8) A special method of procedure is suggested which permits the earliest possible closure of the transverse intestinal fistula

REFERENCES

[1] Becker, A Invagination im Kindesalter Deutsche Ztschr f Chir, 192, 275–280, 1925
[2] Birkenfeld, W Ueber die Darminvagination im Kindesalter Arch f klin Chir, 137, 356–366, 1925
[3] Braun, W Der Darmverschluss Berlin, 1924
[4] Braun, W Die chirurgischen Behandlung des mechanischen Darmverschlusses Quoted in Zentralorgan f die gesamte Chirurgie und ihre Grenzgebiete, 42, Heft 8, 1928
[5] Brown, H P, Jr Acute Intussusception in Children ANNALS OF SURGERY, 81, 637–645, 1925
[6] Close, H G Acute Intussusception in Children, a Statistical Study of 363 Cases at Guy's Hospital Quoted in International Abstract, Supp to Surg Gynec, and Obstet, 54, 340, 1932
[7] Colp, R Enterostomy in Ileus ANNALS OF SURGERY, 98, 1063–1069, December, 1933
[8] Clubbe, C P B The Diagnosis and Treatment of Intussusception London, 1921
[9] Crile, G W Postoperative Complications of Abdominal Operations ANNALS OF SURGERY, 81, 326–329, January, 1925
[10] Deaver, J B The Acute Abdomen Surg, Gynec, and Obstet, 39, 744–749, 1924
[11] Goto, S Ileus Report of the Kyushiu Medical Association, 1927
[12] Gollwitzer, H Statistik uber 223 Ileusfalle Deutsche Ztschr f Chir, 197, 175–179, 1926
[13] Guillaume, A C Les occlusions de l'intestin Paris, 1922
[14] Hashimoto, Y, and Awata, S Statistische Boebachtung des Ileus Ztschr d Japan chir Gesellschaft Jahrgang, 34, Nr 2, 1933
[15] Lee W E, and Downs, T McK The Treatment of Acute Mechanical Intestinal Obstruction by High Temporary Jejunostomy ANNALS OF SURGERY, 80, 45–50, July, 1924
[16] Matsui, H A Statistical Review on the Ileus Kei-o-igaku, 11, No 12, 1931
[17] McIver, M A Acute Intestinal Obstruction, 1934
[18] Menegaux, G Les hernies dites trans-mesocoliques J de Chir, 43, 321–361, 1934
[19] Muzenick, P Der Ileus nach dem Material des 1 Rigaschen Stadtkrankenhauses Deutsch Ztschr f Chir, 202, Heft 5–6, 1929
[20] Nasaroff, N N Enterostomie als Hilfsoperation Deutsch Ztschr f Chir, 190, 113–116, 1925
[21] Obadalek, W Ein Beitrag zum Invaginationsproblem im Kindesalter Beitr z klin Chir, 146, 668–707, 1929
[22] Perlmann, J Klinische Beitrage zur Pathologie und chirurgischen Behandlung des Darmverschlusses Archiv f klin Chir, 137, 1925
[23] Perthes, G Die Behandlung des akuten mechanischen Darmverschlusses Arch f klin Chir, 138, 303–333, 1925
[24] Ravens, C Ueber die operative Behandlung des mechanischen Ileus Deutsche Ztschr f Chir, 241, 668–694, 1933
[25] Shiota, H Todesursache, Diagnose und Behandlung des Darmverschlusses Verhandlungen d Japan chir Gesellschaft, 1933
[26] Takayasu, M Ileus Ztschr d Japan chir Gesellschaft, Jahrgang 11, Nr 3, 1910
[27] Tschmarke, G Bemerkungen zui Indikation und Technik des operativen Dunndarmfistelverschlusses Arch f klin Chir, 169, 754–773, 1932
[28] Vickers, W The Diagnosis of Intussusceptions Quoted in International Abstract Supp to Surg, Gynec, and Obstet, 44, 103–104, 1927
[29] Wada, Y, and Yanagi, J Statistical Review on the Ileus Tohoku Igaku Zassi, 13, No 3, 1930

PERFORATED GASTRIC AND DUODENAL ULCER *

JOHN A McCREERY, M D

NEW YORK, N Y

FROM THE FIRST (COLLEGE OF PHYSICIANS AND SURGEONS) DIVISION OF BELLEVUE HOSPITAL, NEW YORK

ACUTE perforated ulcers of the stomach and duodenum still compose one of the most dramatic of the acute abdominal surgical conditions They are of interest to the physician, who usually makes the diagnosis, to the surgeon who—in his decision as to the character of the operative procedure to be carried out—must be guided not only by the limitations implied by the patient's condition, but also by his own limitations, since these cases are emergencies often cared for by the junior members of the attending staff, and to both in the effect of perforation and procedure upon the underlying condition

A review of recent literature shows that there is still considerable difference of opinion as to the most advisable procedure—ranging from closure alone[1, 2, 3, 4] to—chiefly from German and Russian sources[5]—a large percentage of immediate resections Drainage[2, 6, 7] is "always," "sometimes," or "never" advised

With so much variation of opinion, standardization of procedure is still to be determined, and it, therefore, seems proper to present the experience of a single service, extending over a 16-year period A small group of the earlier cases was reported in 1923[8] This group has been included in the present series

One hundred seventy patients with acute perforated peptic ulcer were admitted to the First Surgical Division of Bellevue Hospital between January 1, 1920, and December 31, 1936 Of these, 162, or 95 per cent, were male Table I shows the age incidence of these cases

TABLE I

AGE INCIDENCE*

Decade	Cases
11–20	3
21–30	37
31–40	40
41–50	34
51–60	33
61–70	12
71–80	2
81–	1
Total	162

* Eight were women, four between 31–40, four between 41–50

* Read before the Association of the Alumni of Bellevue Hospital, New York, May 5, 1937 Submitted for publication August 16, 1937

Perforated ulcer is peculiarly a disease of the male sex and the number of women reported here is larger than those reported in similar series It may be that increased abdominal tension associated with more strenuous occupation has something to do with this difference in incidence At least we believe that increased pressure from the outside has something to do with hurrying an impending perforation, having seen several cases perforate shortly after fluoroscopy or after too thorough examination by a group of students

History—The previous history is of little importance One hundred nine cases, or 64 per cent, gave a history suggestive of ulcer over periods of from one month to 18 years Those with gastric ulcers gave longer histories than those with duodenal ulcers Thirty cases, or 18 5 per cent, had had indefinite indigestion for from two weeks to ten years Thirty-one cases, or 19 1 per cent, had had no previous digestive symptoms, the perforation being the first evidence of disease Five patients had had hematemesis, 13 reported tarry stools, and 20 reported loss of weight up to 40 pounds

Poor economic conditions may be a factor in the frequency of perforations, although there has not been a marked difference in our figures during the past eight years—no more than would be accounted for by the increased demand on a city institution On the other hand, Zukschwerdt and Eck,[9] reporting a series of 117 cases from Heidelberg in 1931, felt that there had been a distinct increase in their cases since 1924, which they thought to be due to improved nutritional conditions

A surprisingly small number of our cases had had previous treatment Twenty-seven had had medical treatment of varying duration and thoroughness, ten had had "chronic appendices" removed with no resultant improvement, and five had had previous perforations In three of these, simple closures had been effected, but it was not possible to determine whether or not the second perforation was at the same site In the others gastro-enterostomies had been added to closure of the perforations, and in both of these the second perforations were in the jejunum one in the proximal loop, the other in the distal One patient had been given osteopathic treatment following the perforation

Symptoms and Physical Signs—These have been described so often that it seems necessary to comment only on the presence or absence of shock We believe that this has been given a much more prominent place in the textbooks than is warranted Shock probably depends upon the size of the perforation and the amount and rapidity of flow of intestinal contents into the peritoneal cavity It was not noted in four cases in which perforation occurred in patients under observation The relative infrequency of shock is suggested by the blood pressure readings on admission In 63 cases which recovered, this varied from 95/60 in a case admitted ten hours after perforation to 170/105 in a patient, age 63, admitted five hours after perforation In only one case was the systolic pressure below 100 In 19 fatal cases the systolic pressure was under 100 in seven, six of which had perforations of over 24 hours' standing

The temperature and pulse are of comparatively little value The temperature on admission was over 100°F in 22 of 134 cases which recovered, and in 12 of 36 fatalities, while the pulse rate was over 100 in 20 cases in each group

Blood counts in the recovered group varied from 3,000, with 86 per cent polymorphonuclears (four hours postperforation) to 29,900, with 85 per cent polymorphonuclears (four hours postperforation), while in the fatal cases the limits were 3,000, with 90 per cent polymorphonuclears (29 hours) and 24,000, with 96 per cent polymorphonuclears (30 hours) (Table II)

TABLE II

WHITE BLOOD COUNTS

Recoveries	Cases	Deaths
Under 10,000 W B C	28	6
10,000–20,000 W B C	69	19
Over 20,000 W B C	21	5

We have made very little use of roentgenologic examinations for diagnosis [11, 12] The symptoms and signs are usually so clear-cut, and the diagnosis so definite, that the delay and, more important, the moving and manipulation of the patient are unnecessary

Finsterbruch and Gross have collected and reported 146 cases in which roentgenologic examination has been used for diagnosis, with 95 per cent correct results They emphasize, however, the fact that the absence of pneumoperitoneum, as shown by the film, does not eliminate the possibility of a perforation being present

TABLE III

PATHOLOGY

Duodenal Ulcers	54			
Indurated		36	Soft	18
Sealed		19	Open	35
Peritoneal Contamination				
None		18		
Moderate		11		
Extensive		23		
Abscess		2		
Gastric Ulcers	109			
Indurated		79	Soft	30
Sealed		24	Open	85
Peritoneal Contamination				
None		20		
Moderate		30		
Extensive		58		
Abscess		1		
Jejunal Ulcers	2[13]			
1 in proximal loop, with acute diffuse peritonitis				
1 in distal loop, with acute diffuse peritonitis				
Undetermined by operation or autopsy—5				

The figures in Table III are open to question because of the difficulty of determining the exact relation of a pyloric perforation to the pyloric vein Forty-five cases were described in the operator's report as "pyloric, probably gastric" or "duodenal" as the case might be These cases have been grouped with those definitely gastric or duodenal for the sake of simplicity

With two exceptions all the perforations were on the anterior wall Two perforated into the lesser sac Both of these were indurated ulcers, open at the time of operation, with extensive contamination of the general peritoneal cavity through the foramen of Winslow Repair of the perforation in these cases is necessarily difficult and unsatisfactory

TABLE IV

BACTERIOLOGY

Cultures taken in 42 cases

20 Sterile (2 over 9 hrs after perforation)
- 14 Primary union
- 2 Wound infection
- 2 Disruption
- 2 Died before wound required dressing

22 Positive cultures* (8 under 6 hrs after perforation)
- 7 Primary union
- 9 Wound infection
- 2 Disruption
- 4 Early deaths

* The cultures in these cases were almost invariably Streptococcus and Staphylococcus Colon bacilli were found only in the late cases

Wilensky,[12] in 1922, suggested that the presence or absence of induration about a perforation might be an indication of the necessity of more extensive procedures than a simple closure—"not necessarily at the time of the perforation" This has not been borne out by our experience in the follow-up, soft and indurated ulcers requiring postoperative care and secondary operation in about the same percentage of cases

TABLE V

PREOPERATIVE DIAGNOSES

These were correct in all but eight cases, namely
- 6 Acute appendicitis
- 1 Acute diffuse peritonitis (cause unknown)
- 1 Bleeding gastric ulcer*

* In the last case hemorrhage and perforation were apparently simultaneous, and the perforation was not suspected, being found at autopsy

The analysis of the operative procedures in Table VI would tend to indicate our preference for conservative measures—especially if one realizes that most of the gastro-enterostomies were performed during the early years considered in this analysis At present it is our belief that closure alone is suffi-

cient, with the rare exception (one in 170 cases in this series) in which extensive induration makes closure impossible, while early operation makes more radical procedure—gastrectomy—justifiable

Obstruction following closure is rare, the edema and infiltration disappearing rapidly, so that immediate gastro-enterostomy is very rarely necessary and early secondary operation unusual

Drainage—We very rarely drain the peritoneal cavity, believing that with closure of the perforation and mechanical cleansing of the peritoneum, the infectious process will be adequately controlled by the individual When secondary abscesses develop—usually subphrenic or subhepatic—they are cared for as may be necessary

TABLE VI

OPERATIVE PROCEDURES

Perforated Duodenal Ulcer
- 36 Duodenorrhaphy
- 15 Duodenorrhaphy and posterior gastro enterostomy
- 3 Duodenorrhaphy and appendicectomy
- 1 Drainage of subphrenic abscess

Perforated Gastric Ulcer
- 87 Gastrorrhaphy
- 7 Gastrorrhaphy and posterior gastro-enterostomy
- 2 Gastrorrhaphy and appendicectomy
- 1 Gastrorrhaphy and pyloroplasty
- 1 Gastrorrhaphy and ligation of lesser curvature vessels
- 1 Gastrorrhaphy and jejunostomy
- 1 Partial gastrectomy
- 1 Appendicectomy (perforation firmly sealed)
- 1 Jejunostomy
- 1 Gastrostomy
- 1 Gastrostomy for posterior perforation
- 2 Drainage of peritoneal cavity

Perforated Jejunal Ulcer
- 2 Jejunorrhaphy

No operation—8

In eight cases no operative procedure was carried out Two of these patients were moribund and in one the perforation was found only at autopsy The other five patients recovered All of these came to the hospital over 24 hours after perforation, with minimal symptoms and physical signs In all the diagnosis was confirmed by roentgenologic examinations which showed free air between the liver and diaphragm

It is our belief that this is not an uncommon event A small perforation occurs at a time when the stomach is empty and is immediately sealed over by omentum or liver If the patient comes under observation early, the signs of peritoneal irritation are marked enough to warrant operation, which reveals a minimal amount of contamination and a perforation already sealed off This picture—minus the signs of peritoneal irritation—is not infrequently seen in interval operations for ulcer Later questioning of these patients may

recall to mind an attack of pain more severe than usual, possibly accompanied by abdominal soreness, but gradually subsiding

TABLE VII

SECONDARY OPERATIONS DURING POSTOPERATIVE STAY IN HOSPITAL

Number of Operations	Nature of Procedure
4	Secondary suture of abdominal wall
3	Jejunostomy
2	Drainage of subphrenic abscess
3	Posterior gastro-enterostomy

Postoperative complications, aside from intraperitoneal abscesses—usually subhepatic or subphrenic—occurred chiefly in the respiratory organs (Table VIII) Their frequency is indicated in the following table

TABLE VIII

POSTOPERATIVE COMPLICATIONS

	Recoveries	Deaths
Pneumonia	22	7
Pulmonary embolus	1	1
Bronchitis	5	
Pulmonary tuberculosis (probably antecedent)	2	

Table IX shows the incidence and nature of the occurrence of nonpulmonary, postoperative complications

TABLE IX

NONPULMONARY, POSTOPERATIVE COMPLICATIONS

	Recoveries	Deaths
Gastric fistula	1	1
Duodenal fistula		1
Cerebral hemorrhage		1
Acute parotitis	2	
Disruption of wound	4	1

Mortality—As in all reported series, the mortality percentage depends almost entirely upon the length of time between the perforation and operation The total mortality in our series was 20 5 per cent—35 deaths in 170 admissions (Table X)

TABLE X

ANALYSIS OF THE 35 PATIENTS THAT DIED

Time between Perforation and Operation	Recoveries	Deaths	Mortality Percentage
1– 6 hrs	87	4	4 3
6–12 hrs	32	8	20
12–24 hrs	9	5	35 7
24–48 hrs	3	12	80
48 hrs and later	2	3	60
No operations	5	3	37 5

Fifteen patients died within 24 hours of operation These were hopeless cases in which operation might well have been refused, but in which it was performed with the feeling that an open perforation was present and that closure offered the patient his only chance

In the three fatal cases in which no operation was performed, two were moribund on admission, while in one massive hemorrhage and perforation occurred simultaneously and the perforation was recognized only at autopsy

There were 17 later deaths (Table XI)

TABLE XI

ANALYSIS OF 17 DEATHS OCCURRING AFTER 48 HRS POSTOPERATIVE

Time of Death	Operation	Cause of Death
3rd day	Gastrorrhaphy	Pulmonary embolus
3rd day	Gastrorrhaphy	Pneumonia
4th day (2 cases)	Gastrorrhaphy	Pneumonia
4th day	Gastrorrhaphy	Acute diffuse peritonitis
5th day	Gastrorrhaphy and pyloroplasty	Acute diffuse peritonitis
5th day	Gastrorrhaphy	Acute diffuse peritonitis and pneumonia
5th day	Gastrorrhaphy	Acute diffuse peritonitis and gastric fistula
7th day	Gastrorrhaphy, secondary jejunostomy	Acute diffuse peritonitis
9th day	Gastrorrhaphy	Acute diffuse peritonitis
10th day	Duodenorrhaphy	Subphrenic abscess, fistula
10th day	Duodenorrhaphy	Hemorrhage
12th day	Gastrorrhaphy, secondary jejunostomy	Acute diffuse peritonitis and pneumonia
13th day	Gastrorrhaphy	Cardiac failure
16th day	Gastrorrhaphy	Secondary perforation
31st day	Gastrorrhaphy and ligation of arteries	Pneumonia
36th day	Jejunorrhaphy	Plastic peritonitis

Follow-Up Results Follow-up in a municipal hospital service is difficult because of the constant shifting of the population—a shift usually carried out without notice to the postal authorities However, we have been able to follow, for varying periods of time, 118 of 135 discharged patients or 87 per cent (Table XII)

Two of these cases came back after ten years or more of complete relief following simple closure of a perforation, with definite ulcer symptoms In these cases we believe that a new ulcer had developed, possibly at the site of a previous perforation, rather than that the ulcer had been persistent, though quiescent, for many years These recurrences, after a long period of time, emphasize how difficult it is to close the "follow-up" of such cases in the belief that the final stage has been reached

SUMMARY —A series of 170 acute, perforated peptic ulcers treated on the First Surgical Division of Bellevue Hospital, between 1920 and 1936, is presented

TABLE XII

RÉSUMÉ OF FOLLOW-UP RESULTS

		Time Followed	Result
DUODENAL ULCER			
29	Closure		
17		2– 90 mos (average 34 mos)	Complete relief
5		6– 34 mos (average 21 mos)	Occasional gas after over-eating
7*		1– 41 mos (average 19 mos)	Recurrent ulcer
14	Closure and Posterior Gastro-enterostomy		
11		2– 9 mos (average 42 mos)	Complete relief
1		12 mos	Occasional gas after over-eating
2		23–132 mos	Recurrent ulcer
GASTRIC ULCER			
61	Closure		
39		2– 93 mos (average 26 mos)	Complete relief
9		3– 42 mos (average 23 mos)	Occasional gas after over-eating
13†		1–123 mos (average 20 mos)	Recurrent ulcer
6	Closure and Posterior Gastro-enterostomy		
4		16 –95 mos (average 58 mos)	Complete relief
1		12 mos	Occasional gas after over-eating
1‡		63 mos	Recurrent ulcer
No Operation			
3			
1		16 mos	Complete relief
1		12 mos	Occasional gas after over-eating
1		2 mos	Persistent ulcer—Posterior gastro-enterostomy with complete relief—42 mos
Miscellaneous Operations			
5	1 Gastrectomy	72 mos	Complete relief
	1 Jejunorrhaphy	28 mos	Complete relief
	1 Drainage of sub-phrenic abscess	32 mos	Complete relief
	1 Appendicectomy (sealed perforation)	4 mos	Complete relief
	1 Jejunostomy (sealed perforation, acute diffuse peritonitis)	50 mos	Occasional discomfort

* Two of these cases have had secondary posterior gastro-enterostomies performed, and have been free from symptoms for 90 and 100 mos respectively The others have refused further operation

† Eight of these patients underwent secondary operations One had an exploratory celiotomy—no lesion found Three had posterior gastro-enterostomies, of which group one was lost from follow-up, the second required revision after 48 mos , and the third had complete relief for 33 mos Four had partial gastrectomies with complete relief for 3, 15, 33 and 60 mos , respectively

‡ This patient underwent partial gastrectomy with complete relief (30 mos)

The predominance of perforations on the anterior surface of the stomach and duodenum is emphasized in this series, as is the relative infrequency of this condition in the female

The importance of early diagnosis and operation is again stressed by our mortality percentages

The difficulty in determining the final result is shown by the cases returning in ten or more years after perforation with recurrence of symptoms

CONCLUSIONS

While the percentage results in the follow-up of a few cases would tend to show that closure plus gastro-enterostomy gave better results, it is our belief that closure alone is the more satisfactory procedure, the alternative in occasional cases with extensive induration making closure difficult—when the patient's condition justifies it—being a partial gastrectomy

Closure alone may necessitate more secondary operations, but will lessen the number of serious secondary procedures such as secondary gastrectomies for marginal ulcer, a procedure which taxes the skill of the most experienced surgeon as well as the resistance of the best prepared patient

REFERENCES

[1] Lang, H J Beitr z klin Chir, 162, 143, 1935
[2] Graham, R R Surg, Gynec, and Obstet, 64, 235, 1937
[3] Sallick, M A ANNALS OF SURGERY, 104, 853, 1936
[4] Gatch, W D, and Owen, J E ANNALS OF SURGERY, 105, 750, 1937
[5] Judin, S S Surg, Gynec, and Obstet, 64, 63, 1937
[6] Eliason, E L, and North, J P ANNALS OF SURGERY, 105, 507, 1937
[7] Eliason, E L, and Ebeling, W W Am Jour Surg, 24, 63, 1934
[8] McCreery, J A ANNALS OF SURGERY, 97, 91, 1924
[9] Zukschwerdt, L, and Eck, T Deutsch Ztschr f Chir, 232, 299, 1931
[10] Pearse, H E, Jr ANNALS OF SURGERY, 96, 192, 1932
[11] Mondor, H, and Porcher, P J de Chirurgie, 41, 20, 1933
[12] Wilensky, A O ANNALS OF SURGERY, 76, 38, 1922
[13] Makkas, M Beitr z klin Chir, 159, 61, 1934

MESENTERIC LYMPHADENITIS AND THE ACUTE ABDOMEN

REPORT OF THIRTEEN CASES

WILLIAM E ADAMS, M D , AND MARY B OLNEY, M D

CHICAGO, ILL

FROM THE DEPARTMENT OF SURGERY AND PEDIATRICS OF THE UNIVERSITY OF CHICAGO CHICAGO, ILL

INFLAMMATION of the mesenteric lymph nodes was recognized and discussed as early as the eighteenth century The diagnosis was usually made after the patient came to autopsy and descriptions of cases were confined chiefly to necropsy examinations Enlarged mesenteric lymph nodes, discrete or matted together, were found showing various degrees of caseation, suppuration, or calcification These were generally assumed to be caused by tuberculosis The term "tabes mesenterica," given to this condition in 1775, by Ball, is still used Tuberculous mesenteric lymphadenitis, as a surgical entity, had received so little attention at the beginning of the twentieth century that Machtle found only 14 cases in the literature in 1909

With the advent of abdominal surgery an increasing number of cases were reported in which an enlargement of the mesenteric lymph nodes was the only finding which explained the clinical syndrome of an acute abdominal condition The lymphadenopathy was commonly thought to be caused by the tubercle bacillus, although many cases revealed only moderate enlargement of the lymph nodes with no matting, caseation, suppuration, or calcification With the development of the Mantoux test and improvement in culture methods there accumulated cases with negative tuberculin reactions having pyogenic organisms in enlarged nodes These cases established nontuberculous mesenteric lymphadenitis as a definite clinical entity Some observers, at present, believe that the tuberculous and nontuberculous adenitis may be different phases of the same disease Because mesenteric lymphadenitis may simulate numerous acute, surgical, abdominal conditions, because it is not uncommon, and because many of its features are not yet fully understood, observations on a series of cases are herewith presented In eight of the 13 cases reported, a positive diagnosis was made at operation In the remaining five a *presumptive* diagnosis of mesenteric lymphadenitis was made, a decision against operation being justifiable in view of our previous experience

CASE REPORTS

Case 1 —No 68665 R S , male, age five, was admitted to the hospital on the evening of July 8, 1933, complaining of severe epigastric pain of two days' duration The parents stated that the child had been well until, two days before admission, he complained of a pain in the left upper quadrant of the abdomen, which was transitory but severe enough to double him up He had a similar attack the evening of the same day and was given castor oil He felt well from then until, on the morning of admission, he complained of

Submitted for publication August 17, 1937

slight pain in the stomach This persisted and was mild in character At noon his mother gave him an enema and he felt relieved An hour later he again had very severe pain which subsided but recurred after an hour It was then situated in the region of the umbilicus and caused the patient to cry He was nauseated but did not vomit There was a past history of "trouble with enlarged tonsils and adenoids"

Physical Examination revealed generalized rigidity over the abdomen without localized tenderness The heart and lungs were negative Rectal temperature 38 3° C , white count 15,800 The urine was negative Roentgenologic study of the abdomen revealed no radiopaque areas within the chest or abdomen A Mantoux test with 1 1,000 tuberculin was positive A diagnosis of acute appendicitis could not be ruled out and an exploratory celiotomy was advised

Operation—The appendix was examined through a right rectus incision It was found to be longer and larger than one would expect in a child of five but was not inflamed It was removed and the stump invaginated There was no Meckel's diverticulum and the bowel wall appeared normal The mesentery, especially at its base near the terminal ileum, contained a large number of swollen lymph nodes Enlarged nodes were also present in other parts of the mesentery The symptoms were attributed to the mesenteric adenitis The cause for the inflammation of the nodes could not be determined The wound was closed without drainage

The patient had a very mild convalescence and the wound healed by primary intention The temperature dropped from 38 5° to 37 8° C within 24 hours and remained at that level or lower during the nine days of hospitalization The patient has had no further symptoms during the 14 months since the operation

Case 2—No 107410 T G, male, age one year, was first seen July 4, 1934, for a complaint of periodic cramping abdominal pains of 24 hours' duration An accurate history was difficult to obtain because of the parent's lack of intelligent observation The child was admitted for emergency treatment He had been perfectly well until 24 hours previously when he began to vomit "yellow material" and to have periodic abdominal cramps About six hours before admission the vomiting and pain became very severe There was no history of bloody stools The child had been constipated for 36 hours but an enema had given no result

Physical Examination revealed a pale, very acutely ill child with grunting respirations Temperature 37 5° C The heart and lungs were normal The abdomen was fairly soft and a mass was palpated in the right lower quadrant, on the bimanual examination No blood was found on rectal examination The white cell count was 41,500 Intussusception in the region of the ileocecal valve was suspected and operation was advised The patient was given 500 cc of Ringer's solution containing 25 Gm of glucose subcutaneously

Operation—Under local anesthesia, a right, midrectus incision was made The mass palpated before operation was an enlarged right kidney lying in the region of the right iliac fossa The small and large intestines were of normal size and color The appendix appeared normal The mesentery of the ileum was studded with enlarged lymph nodes, ranging from 1/3 to 1½ cm in diameter The appendix was removed and the wound was closed without drainage The child's condition appeared unchanged for about four hours, when he suddenly became worse The temperature rose to 39° C, and the child expired five and one-half hours after operation A postmortem examination was refused

Case 3—No 91730 E G, female, age seven, was seen November 13, 1933, for a complaint of pain in the region of the umbilicus, and vomiting About three months before admission, while at school the child vomited and developed pain and tenderness in the region of the epigastrium This attack was of very short duration (about one day) and no more symptoms presented until about one month later, when she had a similar attack, and a third one month before admission At that time her temperature was 38 9° C , white count 28,000 There was slight tenderness about the umbilicus, otherwise

the physical examination was negative Her white count dropped to 12,000 within three days

The present attack began November 12, 1933, when she awoke complaining of pain and tenderness in the region of the umbilicus She vomited once at that time Temperature on admission 38° C The white count was 5,600

Physical Examination revealed subacutely inflamed tonsils, and there was a faint systolic murmur at the apex of the heart There was some tenderness about the umbilicus, but there was no distention There were no palpable masses in the abdomen A definite diagnosis could not be made However, a recurring appendicitis or a Meckel's diverticulitis was considered After the administration of fluids the white cell count was 10,800 Roentgenologic examination of the entire G I tract was normal Four days after admission, operation was advised

Operation—The abdomen was opened through a lower right rectus incision The appendix appeared entirely normal There was no evidence of a Meckel's diverticulum Eight or ten enlarged lymph nodes were found in the mesentery at the ileocecal junction, and many more were found in the mesentery of the ileum higher up These nodes were very light pink in color with a granular appearing surface Two were removed for culture and microscopic examination The appendix was removed and the wound was closed without drainage

Microscopic Examination of the appendix revealed marked lymphoid hyperplasia but no evidence of inflammation Culture of the mesenteric lymph nodes showed *Streptococcus viridans* No signs of tuberculosis developed in a guinea-pig inoculated with material from the nodes A Mantoux test with 1 100 tuberculin showed no reaction The child made an uneventful recovery and has had no recurrence of symptoms

Case 4—No 110514 S W, male, age nine, was admitted to the hospital August 17, 1934, with a complaint of vomiting for the preceding three and one-half hours He stated that the night before he had been "sick to his stomach" He had been given an "Ex-Lax" tablet and had gone to sleep but awakened at midnight with pain about his umbilicus The following morning he began to vomit and continued to vomit for about three and one-half hours He had taken nothing by mouth since that time The bowels had been regular and there had been no urinary complaints The past history was irrelevant

Physical Examination—The patient was well developed and well nourished Rectal temperature 38 2° C The tonsils were small and definitely inflamed There was localized tenderness over McBurney's point which radiated to the umbilicus Rectal examination was negative There was a leukocytosis of 19,900 The urine was normal A diagnosis of acute appendicitis could not be ruled out and operation was advised

Operation—The appendicectomy was performed through a McBurney's incision The appendix showed no evidence of infection There were several enlarged lymph nodes in the mesentery of the ileocecal region

Microscopic Examination of the appendix revealed no evidence of infection The patient had a very mild convalescence and was discharged 12 days after operation

Case 5—No 88144 M S, female, age nine, had been hospitalized for treatment of a congenital dislocation of the hip She had been put in skeletal traction by means of a Steinman pin when her first symptoms occurred The Steinman pin had been inserted November 2, 1934, under nitrous oxide anesthesia She had had a mild convalescence, during which her rectal temperature ranged from 37 3° to 37 8° C, then dropped to 37 5° C On the following evening it again rose to 38 4° C, and the patient became flushed and had generalized abdominal pain that centered about the umbilicus She vomited twice and refused her supper There was some tenderness in the right lower quadrant and the abdomen was somewhat distended The throat was slightly reddened, and there was a slight amount of inflammation about the Steinman pin The heart and lungs were normal, pulse 140, white blood count 26,750 On the following morning the white blood count was 18,000, the urine was negative except for many white blood cells The urine examined was a voided specimen and the cells were thought to be from a vaginal dis-

charge The child had a definite, atypical rash The abdominal rigidity became greater on the right side and the tenderness extended from the right lower quadrant upwards and laterally to the kidney region The white blood count was 22,150 A catheterized specimen of urine revealed clumps of renal epithelium cells and some white blood cells The differential diagnosis apparently lay between an acute appendicitis, infection from the Steinman pin, and a right pyelitis The severity of the symptoms and absence of definite diagnostic features made exploratory celiotomy advisable

Operation—A right midrectus incision was made under ethylene anesthesia No free fluid was found in the abdomen The appendix presented some fibrous adhesions as evidence of an old inflammation but otherwise was perfectly normal It was removed The right kidney region and the pelvis revealed nothing abnormal The mesentery of the small intestine presented numerous enlarged lymph nodes The wound was closed without drainage Following operation the patient's temperature and pulse returned to normal within three days The abdomen became soft and there was no further complaint of abdominal distress

Microscopic Examination of the appendix revealed it to be normal The wound healed by primary intention and the patient had a shelf operation for congenital dislocation of the hip three weeks later

Case 6—No 75822 F G, male, age seven and one-half, was treated for tuberculosis of the left foot and kidney during the year previous to his present complaint The left kidney had been removed His present complaint was acute generalized abdominal pain with nausea and vomiting, of three or four days' duration His pain then became localized in both lower quadrants

Physical Examination showed right lower quadrant rigidity and some right rectus spasm There was tenderness on deep pressure in both lower quadrants, with some rebound tenderness Rectal examination revealed some tenderness and a mass in the right iliac fossa One hour after admission the white blood count was 16,300 and the temperature 38 2° C The urine showed three plus albumin, was loaded with pus and contained an occasional red blood cell A white blood count three hours after admission was 18,300 Because of the mass in the right lower quadrant and the rigidity at that point and the fairly typical history of acute appendicitis, it was decided to perform an exploratory celiotomy

Operation—The appendix was examined through a McBurney's incision It appeared normal The very small amount of free fluid in the abdomen was cultured The mesentery of the terminal ileum revealed many enlarged lymph nodes 2 to 8 Mm in diameter This portion of the bowel appeared hyperemic, and a small nodule about 1 Mm in diameter was present in its wall There were two walnut-size lymph nodes in the mesenteric attachment of the cecum A small lymph node in the mesentery was removed for examination The appendix was removed and the wound was closed The patient made an uneventful convalescence and the wound healed by primary intention

Microscopic Examination of the appendix showed it to be normal The lymph nodes showed only hyperplasia Cultures of the fluid and lymph nodes were negative About three months later the patient developed signs of tuberculous meningitis and died He had had no abdominal complaints after operation No autopsy was obtained

Case 7—No 115483 S F, female, age 13, was admitted to the hospital with a complaint of recurrent attacks of sharp, shooting pain in the right lower quadrant of two years' duration She stated that the pain in the right lower quadrant in the first attack two years before admission was severe enough to cause her to lie down The pain lasted two or three hours Since that time she has had an attack about once a month, each attack persisting for almost a week The pain was somewhat "shooting" in character and mostly in the right lower quadrant It came on mostly at night and would last two or three hours The remainder of the attack was characterized by a dull ache and tenderness in the right lower quadrant The attacks were often accompanied by fever and occasionally by vomiting Five months before admission she was seen during an attack

and a diagnosis of recurrent, subacute appendicitis was made She was put on a liquid diet at that time Two weeks before admission, the present attack came on, which has persisted This episode has persisted longer than any previous one She believed she had had some fever but there had been no vomiting Some foods aggravate the pain She had remained in bed most of the two weeks before admission Her bowels had been regular

Physical Examination—The patient appeared very well nourished and did not look ill The general examination was normal Blood pressure 117/70, pulse 100 The heart and lungs were normal An examination of the abdomen revealed tenderness in the right lower quadrant, localized to McBurney's point No muscular spasm or palpable masses could be detected The white blood count was 9,000, temperature 37 9° C , urine normal

It was thought best to observe the patient No change was noted after 48 hours Operation was performed, because of the frequency of the attacks and because of the parent's request

Operation—The appendix was examined through a muscle-splitting incision, and found to be somewhat hyperemic, but not acutely inflamed The lymph nodes in the mesentery of the distal ileum were as large as 1 cm in diameter One was excised for study The appendix was removed and the wound closed without drainage

Microscopic Examination of the appendix revealed it to be normal The lymph node was hyperplastic Cultures of a portion of the lymph node gave no growth The patient had an uneventful convalescence and was discharged a week later She has had no recurrence of symptoms during the two months which have elapsed since operation

Case 8—No 127288 B S , female, white, age ten, was first seen May 1, 1935, complaining of abdominal pain of two days' duration The patient had remained at home from school because of the abdominal pain on the right side accompanied by nausea and vomiting This continued throughout most of the night Her bowels had been normal but she was given an enema without results This was then followed by castor oil On the day of admission the pain had persisted, being located over the right side of the abdomen The past history revealed that the patient had had ten attacks during the past seven or eight months, each consisting of cramping abdominal pain in the right side of the abdomen, usually lasting for several hours She was frequently nauseated but did not vomit On one occasion the attack was diagnosed as acute appendicitis but operation was not advised The remainder of the past history was irrelevant

Physical Examination—The patient's face was flushed Temperature 99 4° F The tonsils were not large but the mucous membrane was reddened The heart and lungs were normal, pulse 120 The abdomen presented tenderness over the entire right side and along the left costal margin There was no rigidity Rectal examination was normal Urine negative White blood cells 9,300, hemoglobin 81 per cent, and red blood cells 4,070,000 A diagnosis of acute appendicitis was considered and operation advised

Operation—On opening the abdomen the appendix was found to be grossly normal Many enlarged lymph nodes were present in the mesentery of the small intestine There was no free fluid The appendix was removed and the abdomen closed without drainage Microscopic examination of the appendix revealed no abnormalities The patient had an uneventful convalescence The pulse and temperature returned to normal and the patient was discharged one week after admission

CASE HISTORIES OF FIVE PATIENTS IN WHOM A PRESUMPTIVE DIAGNOSIS OF MESENTERIC ADENITIS WAS MADE, BUT WHO WERE NOT OPERATED UPON

Case 9—No 106319 L H , female, age ten, was seen August 11, 1934, complaining of a sharp pain in the right side, of 24 hours' duration The mother stated that for two or three days the child had had a poor appetite and had not been playing During the evening before admission there had been a gradual onset of right lower quadrant pain which later shifted to below the ribs The child slept well that night but the following morning the pain was quite severe and had remained so all day There had been no

nausea or vomiting and the bowels had been normal There had been no urinary complaints There was a history of two other attacks of less severity, the first two years and the second three months previously The past history otherwise was irrelevant

Physical Examination revealed a well developed girl who seemed acutely ill She lay on her right side to ease her pain The findings on general examination were normal except for large, cryptic tonsils Blood pressure 105/55, pulse 90 Examination of the abdomen disclosed slight muscular rigidity, tenderness both in the upper and lower right quadrants, somewhat more pronounced in the lower Temperature 38 9° C White blood cells 12,500, 95 per cent hemoglobin, red blood cells 4,620,000 The urine findings were normal Acute appendicitis was suspected but because of the lack of localized findings it was thought best to defer operation temporarily and to observe the patient Two subsequent white counts showed little change However, on the following day two white counts were 6,500 and 6,800, and the temperature had returned to normal The patient was discharged a day later She was seen in the Clinic two days after discharge, at which time there were no complaints and no abnormal findings She was asked to return if further symptoms developed but has not done so

Case 10—No 99438 P D, male, age five, was seen first August 12, 1934, for a complaint of abdominal pain of three days' duration On August 10 he awoke and told his mother that he had felt like vomiting before he went to sleep During that day and on the previous day, he had had three or four watery, light brown stools and had complained of pain in the abdomen The mother thought the child's pain was worse on the right side On the following morning he was quite cross and irritable and complained of a frontal headache and of abdominal pain, especially on coughing He continued to eat his meals regularly and had no stools that day He went to bed at the usual time but awoke two and one-half hours later screaming with pain and doubled up in bed There was no history of the patient's having had anything out of the ordinary to eat

Physical Examination revealed a well developed boy whose abdomen was held quite rigid There was generalized tenderness but more so on the right side than on the left The findings on rectal examination were normal White blood cells 11,600 The urine was normal Because of the lack of localized findings a definite diagnosis was not made and observation was advised A white cell count taken one hour later was 13,700 and on the following morning it was 13,600, and about the same six hours later However, by this time there was very little pain and although there was some tenderness over the entire right abdomen, it was not marked and there was only a very slight degree of right rectus rigidity Temperature on admission was 38 6° C, 24 hours later it was normal and remained so thereafter The white count remained as high as 12,000 although the findings and symptoms had completely subsided The patient did not keep a return appointment in the Out-Patient Clinic

Case 11—No 55205 D G S, female, age 11, was admitted February 12, 1932, with a complaint of intermittent abdominal pain confined usually to the right side Six weeks before admission the patient first noticed intermittent abdominal pain One day it was accompanied by vomiting and diarrhea and was so severe that she was confined to bed Temperature 38 9° C Since then she had had an average of two attacks a week characterized by sudden onset of abdominal pain which would "double her up" These attacks were not accompanied by vomiting or other symptoms and have not prevented attendance at school

Physical Examination revealed a well developed, well nourished girl She appeared somewhat pale and her pharynx was injected The general examination was normal, except for some coarse râles in the right apex Her abdomen was somewhat tender in both lower quadrants Temperature 37 6° C Examination of the blood and urine revealed no abnormal findings The Mantoux test with 1 100 tuberculin was negative Roentgenologic examination of the chest and of the genito-urinary tract revealed no abnormalities The diagnosis at this time was slight upper respiratory tract infection and mesenteric lymphadenitis She was seen again February 27, 1932, when a small mass was palpated

in the left lower quadrant There were no complaints at that time She was seen at intervals of four to eight weeks during the next two and one-half years The mass in the left lower quadrant remained about the same size and was fairly freely movable until January, 1934, when it appeared to be getting smaller However, it was still palpable when the patient was last seen in June, 1934 It was not tender and quite freely movable and was thought to be a mesenteric lymph node There was no recurrence of abdominal pain or of vomiting

Case 12—No 74086 R M D, female, age six, was admitted April 27, 1935, complaining of diarrhea and vomiting of two days' duration Two days before admission the patient complained of a distended abdomen The following day she had not felt well but ate her meals About ten o'clock, the night before admission, she began vomiting and had several liquid stools, there was low abdominal pain of a cramping nature The pain was localized first around the region of the umbilicus and later in both lower quadrants There was no respiratory infection The abdominal pain continued up to the time of admission

Physical Examination—The patient did not appear acutely ill The abdomen was generally rigid She complained very little of pain or tenderness on examination Rectal examination was normal and on the insertion of a rectal tube, a liquid stool was obtained General examination was otherwise quite normal White blood cells 18,000, urine normal, temperature 37 7° C

It was decided to observe the patient over night Saline and glucose were given subcutaneously On the following day, the white count was about the same and the urine was normal Her rectal temperature remained below 38° C during her entire stay in the hospital, which was five days Four days after admission, the white count was 14,000, the abdomen became soft and there was no more vomiting or diarrhea during her entire stay The stools were negative for *Endameba histolytica* Roentgenograms of the chest were normal

Case 13—No 62254 R C, male, white, age seven, was admitted January 29, 1935, complaining of abdominal pain of six months' duration The patient had been quite well until September, 1933, when he had an attack of severe vomiting and abdominal pain and a fever as high as 105° F

He was seen at the Cook County Hospital, where little rigidity or tenderness was found on examination, and he was allowed to go home He was readmitted October 3, 1933, and a normal appendix removed The patient stated that several days after the operation the wound broke open and drained, off and on, for several weeks He was well until the following August, 1934, when he had an attack of diarrhea and pain in the abdomen which caused him to "double up" The pain was located around his waist and he was treated for colitis The attack occurred every few weeks thereafter, until his present trouble which began a few days before admission and was very similar in character to those previously suffered

The past history revealed that in March of 1933, six months before the first described attack, the patient was seen at a Pediatric Clinic having symptoms of bronchitis and pain in the abdomen A diagnosis of mesenteric lymphadenitis was made at that time On questioning the mother, she stated that the recurring attacks of abdominal pain were definitely related to recurring upper respiratory tract infections

Physical Examination—The patient did not look acutely ill There was evidence of a subsiding pharyngitis with enlarged cervical lymph nodes The heart and lungs were normal The abdomen was full and was held voluntarily tense all over, but was not tender There were no masses An operative scar was present in the right lower quadrant Rectal examination was negative Urine normal White blood cells 8,500, hemoglobin 85 per cent, red blood cells 4,800,000 A tuberculin test of 1 to 1,000 dilution was negative, and examination of the stool was negative for parasites Roentgenologic examination of the G I tract was normal and showed no calcification of the mesenteric nodes A diagnosis of subsiding upper respiratory infection and subacute mesenteric

lymphadenitis was made The patient was put on a controlled medical regimen and discharged one week after admission He was followed in the Out-Patient Clinic, and when seen three months later had been having no further trouble

TABLE I

RESUMÉ OF 13 CASES OF NONTUBERCULOUS LYMPHADENITIS

	Number of Cases
Incidence	
Season	
Spring	4
Summer	1
Autumn	5
Winter	3
Repeated attacks	9
Associated with upper respiratory infections	8
Operated	8
Symptoms	
Nausea	10
Vomiting	9
Diarrhea	5
Colic	10
Pain	
Epigastric	1
Umbilical	3
R L Q	2
Right side	4
Generalized	6
Signs	
Temperature	
37 0° to 38 5° C	9
38 5° C	4
Tenderness	
Epigastric	1
Umbilical	0
R L Q	3
Right side	3
Generalized	3
Rigidity (including resistance)	
R L Q	1
Right side	3
Generalized	5
Findings	
W B C	
8,000 to 15,000	5
15,000	8
Culture of lymph node	2
Positive for hemolytic streptococcus	1
Guinea-pig inoculation	2
Positive for tubercle bacilli	0

Etiology—The factors which contribute to the production of nontuberculous lymphadenitis remain obscure Mead[6] has discussed the etiologic

theories on this subject advanced by various authors When the disease first became a definite clinical entity, all cases were thought to be tuberculous This misconception was corrected when guinea-pigs injected with material from nodes removed at operation remained free of tuberculosis The Mantoux test, also, did much to differentiate the two types preoperatively and to establish the nontuberculous variety as a definite group of cases of different etiology Recent reports reveal the nontuberculous type to be much more common than the tuberculous

Of all possible etiologic factors of the nontuberculous type, the appendix has probably received most consideration Although most cases have become symptom free following appendicectomy, this is not proof that the appendix was at fault That many cases become symptom free on controlled medical management, and further that enlarged mesenteric nodes rarely are present in cases of uncomplicated acute appendicitis, are convincing evidence that the appendix is not the cause of the condition Further evidence against this theory is the routine finding of an appendix which reveals no gross or microscopic pathologic change and the persistence of symptoms in a few cases following appendicectomy

The colicky, intermittent character of the abdominal pain, with diarrhea in some cases, and dehydration, suggests the intestine as a likely etiologic factor However, at operation the bowel appears normal on gross inspection That the condition may be only a local manifestation of a generalized condition must be strongly considered Nine of our 12 cases of the nontuberculous type occurred in the spring or autumn, and eight were definitely associated with an upper respiratory infection In one case the abdominal symptoms recurred with each flare-up of his upper respiratory condition, this after a normal appendix had been removed, elsewhere, two years previously Both conditions subsided completely on controlled medical management In one case hemolytic Streptococci were isolated from a mesenteric lymph node This finding is in accord with that of Goldberg,[4] who cultured the Streptococci from the throat and from the nodes in a series of cases

Clinical Manifestations—Two of the most outstanding features of this condition are the colicky nature of the abdominal distress and the marked tendency for recurrence of attacks This has been reported repeatedly by other authors and was observed in most of our cases Not infrequently there is a history of a recent upper respiratory infection, and it is not unusual to find either an active condition present or remnants of a previously existing one Although some authors have reported the greatest age incidence to be between 20 and 30 years (Freeman[3]), most cases are perhaps younger than this All of the cases herein reported were less than 14 years of age

The attacks usually come on quite suddenly and the patient is "doubled up" with cramping pain in the abdomen, which lasts from a few minutes to one or two hours In half of our cases this pain remained generalized and in only two was it localized in the right lower quadrant The attacks were

accompanied by nausea and vomiting in most of the cases and five cases had an associated diarrhea

Examination revealed tenderness localized to the right lower quadrant in only three cases The others presented tenderness over both sides of the abdomen or over one entire side Right rectus rigidity was present in only four cases The others presented a generalized resistance or none at all

Another striking feature is the frequency of an elevated white cell count out of all proportion to the patient's temperature This seemed to be more obvious in the earlier attacks Several of our cases had a leukocytosis of 20,000 or above, and one had a white cell count of 41,000, only four had a temperature over 38 5° C Abdominal masses usually are not palpable in the nontuberculous variety

Diagnosis—A definite diagnosis of nontuberculous lymphadenitis in most cases is very difficult to make before operation Its clinical picture is so variable that McFadden[5] says "There is hardly an abdominal condition for which laparotomy is commonly performed that may not be simulated by diseased mesenteric glands" It is almost invariably confused with acute appendicitis and must also be differentiated from pyelonephritis, intussusception, and Meckel's diverticulitis

The history of many previous attacks and the colicky nature of the abdominal pain together with the lack, in many cases, of localizing signs or symptoms are helpful in arriving at a definite diagnosis When possible, observation of the patient for a few hours following admission may be very helpful Nine of our 13 cases were operated upon One of these was of the tuberculous variety and one had had an appendicectomy elsewhere about a year before admission

Pathology—At operation all of our cases presented practically the same picture There was usually little or no free fluid in the peritoneal cavity and, if present, was sterile on culture The appendix appeared normal or slightly hyperemic The peritoneum of the mesentery and the bowel wall appeared normal The mesenteric lymph nodes at the ileocecal junction and extending upward on the ileum were enlarged from 0 5 to 1 5 cm in diameter and were somewhat flattened The greatest collection of enlarged nodes was at the ileocecal junction They were discrete and pinkish in color and on removal presented a granular appearance Other authors have reported finding enlarged nodes in various parts of the mesentery, some showing necrosis, caseation, or calcification (Mead[6]) Exploration was limited in our operated cases and autopsy was denied in one fatality Thus the findings are limited to a local area

Microscopic sections revealed only lymphoid hyperplasia

A *Streptococcus hemolyticus* was cultured from a removed node in one of two cases and guinea-pig inoculations were negative in the two cases in which this was done

The one case of tuberculous mesenteric lymphadenitis presented several very large (2 0 cm) nodes matted together near the ileocecal junction

There were many smaller ones in the mesentery of the ileum extending above this region

Treatment and Prognosis—In most cases where the diagnosis is uncertain, exploratory celiotomy is indicated In some cases it is possible to observe the patient for several hours before a definite type of treatment is decided upon Restoration of fluid and mineral balance and limitation of intake by mouth to a minimum may be carried out while waiting to decide if operation is advisable

A rapid subsidence of abdominal symptoms and pathologic findings is very helpful in determining the true nature of the condition This period of observation need not be longer than two or three hours, and if the symptoms and findings make delay seem hazardous, exploration should be carried out at once The danger accompanying exploratory celiotomy and appendicectomy is little compared to that associated with complications arising from a mistaken diagnosis

When exploration was undertaken, removal of the appendix was the routine Lymph nodes were removed only for diagnosis

Except for the one fatality all cases of the nontuberculous variety, whether operated upon or not, have made complete recoveries on a controlled medical, dietary and hygienic management All authors have stressed these as important measures in the treatment of the disease There is little evidence to support the opinion that appendicectomy is necessary to obtain a permanent cure

The one case of the tuberculous type died several months postoperatively from tuberculous meningitis

SUMMARY AND CONCLUSIONS

(1) Twelve cases of nontuberculous and one of tuberculous mesenteric lymphadenitis have been reported and discussed

(2) Although the appendix and small intestine have received the major consideration as etiologic factors in the production of this condition, it is not unlikely that enlarged mesenteric lymph nodes are only a local manifestation of a generalized condition having its origin in an upper respiratory tract infection

(3) The colicky nature of the abdominal distress, the multiplicity of attacks with relatively short duration and frequent association with an upper respiratory tract infection are outstanding characteristics of the disease

(4) The disease is chiefly one of children, all of our cases being under 14 years of age The average age reported by most authors is below 20 years

(5) Nontuberculous lymphadenitis must be differentiated from acute appendicitis, pyelonephritis, Meckel's diverticulitis, and intussusception

(6) The diagnosis usually is made at operation However, the colicky nature of the pain and lack of localized symptoms or findings in cases which may be observed for a few hours may lead to a correct diagnosis without

operation This is especially true where there is a rapid subsidence of symptoms and findings, a course which is often observed in this condition

(7) Simple lymph node hyperplasia of the mesenteric nodes in the region of the ileocecal junction and, to a lesser extent, in the mesentery of the lower ileum, is the usual pathologic finding Occasionally pyogenic organisms may be cultured from these nodes

(8) Exploratory celiotomy is the treatment of choice, especially where a definite diagnosis cannot be made The appendix is removed and the wound is closed without drainage

(9) The prognosis for a permanent cure is very good Most cases remain symptom free following appendicectomy This is also the case where controlled medical management and antituberculosis measures are observed in nonoperated cases

(10) Only one case of tuberculous lymphadenitis has been observed as compared to 12 nontuberculous cases, thus showing the relative incidence of the two This conforms favorably with the statistics of other authors

REFERENCES

[1] Brennemann, Joseph Abdominal Pain of Throat Infections Am J Dis Children, 22, 493–499, November, 1921, The Abdominal Pain of Throat Infections in Children J A M A, 89, 2183–2186, 1927

[2] Brown, H P Acute Mesenteric Adenitis Simulating Appendicitis Surg Clin N America, 9, 1195–1196, 1929

[3] Freeman, Leonard Chronic Non-specific Enlargement of the Mesenteric Lymph Nodes as Related to Surgery ANNALS OF SURGERY, 90, 618–630, 1929

[4] Goldberg, Samuel L, and Nathanson, Ira T Acute Mesenteric Lymphadenitis A Clinical Syndrome in Children Simulating Appendicitis Am J Surg, 25, 35–40, 1934

[5] McFadden, G D F Mesenteric Adenitis and Its Clinical Manifestations Brit Med Jour, 1174, 1927

[6] Mead, C H Mesenteric Lymphadenitis Simulating Acute Appendicitis Arch Surg, 30, 493, 1935

[7] Speese, John Mesenteric Adenitis Penn Med Jour, 32, 225-228, 1929

[8] Wilensky, A O, and Hahn, L J Mesenteric Lymphadenitis ANNALS OF SURGERY, 83, 812–826, 1926

THE PATHOGENESIS OF NECROSIS OF THE CEREBRAL GRAY MATTER FOLLOWING NITROUS OXIDE ANESTHESIA *

CYRIL B COURVILLE, M D

LOS ANGELES, CALIF

FROM THE DEPARTMENT OF NEUROLOGY, COLLEGE OF MEDICAL EVANGELISTS, AND THE CAJAL LABORATORY OF NEUROPATHOLOGY, LOS ANGELES COUNTY HOSPITAL, LOS ANGELES, CALIFORNIA

DURING the past five years, the writer has had the opportunity of studying the clinical manifestations and, in the fatal cases, the pathologic alterations in a number of patients who presented untoward symptoms, indicative of cerebral damage, after nitrous oxide anesthesia A résumé of the 13 cases studied, nine of which came to autopsy, have been reported elsewhere [1]

As a rule, these patients developed respiratory or cardiorespiratory failure while under nitrous oxide-oxygen anesthesia and failed to regain consciousness when the anesthetic was withdrawn During the survival period the patients remained in coma, frequently had convulsions and most of them died in a state of hyperthermia after an interval of one and one-half to 26 days A few individuals recovered, some with a residual lenticular syndrome,[2] others with a permanent psychosis,[3] while some fortunately recovered completely In the fatal cases, the cerebral cortex and the lenticular nuclei presented areas of necrosis which at times became confluent and, if the survival period was sufficiently long, resulted in astrovascular scars Because of their histologic characteristics, these lesions were believed to be the result of asphyxia, a conclusion which was supported by Dr Yandell Henderson

In a recent study by Lowenberg, Waggoner and Zbinden,[4] four similar cases were reported, pathologic examinations of the brain being made in the three fatal cases The cerebral cortex and basal ganglia presented characteristic areas of necrosis As a result of their observations, these investigators concluded that the cerebral damage was due to the toxic action of nitrous oxide

Thus both of the two possible causes have been held to be responsible for the injury to the cerebral gray matter The writer has taken occasion to review his material to see whether the morphologic changes found gave support to either of these two theories This review was made with a realization of the difficulty of attempting to explain abnormal physiology on the basis of structural alterations A final conclusion can be reached only after the problem has been attacked from the physiologic and pharmacologic aspects as well

Mode of Action of Nitrous Oxide.—It is necessary to review briefly the mode of action of nitrous oxide in anesthesia, to determine whether its action

* Read before the Anesthetist's Travel Club in Los Angeles, January 5, 1937 Submitted for publication August 17, 1937

is due primarily to some specific narcotic effect or to an associated or resultant asphyxia From a physiologic standpoint, nitrous oxide does not behave entirely like a pure asphyxial gas (a) The pulse is not so slow (the cardioinhibitory center is less capable of activity), (b) convulsive movements are less marked (due to depression of the motor nerve cells), and (c) respiration ceases earlier (due to a specific depressant action on a respiratory center) This specific depressant action of the gas is noted when it is used even in dilute solution with oxygen, distinct narcotic effects being produced in proportions of one to four It has also been shown that this narcotic action disappears immediately when nitrogen, which is an inert gas, is substituted for nitrous oxide, under which circumstances the patient promptly recovers These observations indicate, therefore, that nitrous oxide does exert a distinct narcotic effect *per se*

How much of the effect of nitrous oxide is due to asphyxia? The early investigators, Bert[5] and Martin[6] were of the opinion that death was due to lack of oxygen rather than to any depressant effect of nitrous oxide on the respiratory center From a purely clinical standpoint, Hewitt[7] believed that the obstructive stertor, convulsive movements and cyanosis occasionally seen with nitrous oxide anesthesia were of anoxemic origin and were not essential to anesthesia As a result of their experimental investigations as to the amounts of oxygen, carbon dioxide and nitrous oxide concentration in the blood of dogs under nitrous oxide anesthesia, Leake and Hertzmann[8] concluded that surgical anesthesia was invariably accompanied by some degree of anoxemia Greene[9] and his collaborators reached the same conclusion and found that a high concentration of the gas was necessary for surgical anesthesia in experimental animals Their work made it seem evident that the depth of anesthesia depended not as much on the concentration of nitrous oxide in the gas breathed as it did on the variations of the percentage of oxygen

Brown, Lucas and Henderson[10] state that "patients anesthetized with nitrous oxide will always suffer from a severe degree of anoxemia and that this must impose a limitation upon its use and increase its danger" As a result of experimental work and of clinical observation,[11] one must, therefore, conclude that surgical anesthesia with nitrous oxide is accompanied by advanced degrees of anoxemia and, therefore, that anoxemia must be given serious consideration as a possible cause of untoward neurologic manifestations

The Toxicology of Nitrous Oxide—The undesirable manifestations of any anesthetic agent may be the result of its inherent toxic properties or the production of undesirable physiologic states which it creates or due to secondary complications which it encourages The untoward effects of nitrous oxide may well be considered on this basis Experimentally, it seems fairly clear that the actual narcotic action of nitrous oxide is of little moment insofar as its fatal effects are concerned This is shown by the fact that animals die in about the same length of time after inhalation of nitrous oxide as with an inert gas

such as hydrogen [12] Its anoxemic or asphyxial effect must, therefore, be given consideration as the cause of untoward symptoms

Anoxemia and Nitrous Oxide Anesthesia—There are three types of anoxemia depending upon the factor producing it (Barcroft) The *anemic type* is due to deficient amounts of hemoglobin which makes it impossible to carry a normal amount of oxygen, even though the oxygen tension in the blood is normal The *stagnant type* of anoxemia results from a slowing of the circulation, as following cardiac failure The oxygen content and the oxygen tension are normal under these circumstances but the amount of oxygen actually supplied to the tissues in a given interval of time is reduced The *anoxic type*, which is the most serious of the three, is a result of lowering of oxygen tension in the blood so there is actually less oxygen in solution This usually results in a coincident lowering of the carbon dioxide tension which further decreases the rate of dissociation of hemoglobin so that the oxygen present is not so readily available to the tissues In nitrous oxide anesthesia we are dealing with anoxic anoxemia resulting in a reduction in the actual amount of oxygen available in the blood This is true even when pure oxygen is given under pressure with the gas The oxygen tension in the blood is lowered and, therefore, the amount of oxygen available to the cerebral cells is reduced This anoxic type of anoxemia may be accentuated by mechanical difficulties in the apparatus and obstruction of the respiratory passages

The untoward symptoms of nitrous oxide anesthesia may be mild or severe The mild transient symptoms are cyanosis, respiration, irregularities and muscular twitchings or grosser, uncontrolled muscular movements or even convulsions At times stupor or mental cloudiness may persist for a variable interval after withdrawal of the anesthetic Restlessness, irrationality, hysterical outbursts or most prolonged psychoses have also been described Among the more serious eventualities are more or less severe and persistent neurologic manifestations of psychic, motor or sensory character Persistent manifestations indicative of injury to the lenticular nucleus may be present in some cases In others the resultant psychosis may be so marked as to require hospitalization Such patients may succumb after an interval of days, weeks or even months after anesthesia It is in this group of cases that cerebral damage can be demonstrated postmortem In another group of cases, sudden death occurs under the anesthetic Excluding those cases with an advanced surgical lesion, the immediately fatal issue has been attributed to persistent thymus, idiosyncrasy, pressure on the carotid sinus or to direct depression of the respiratory center by the gas

In a recent report Lowenberg, Waggoner and Zbinden[4] analyzed a series of four patients who presented serious residual manifestations, and discussed the mechanism of cerebral change They believe that (*a*) Asphyxia following nitrous oxide anesthesia may be produced by lowering the oxygen content of the blood, or (*b*) That it may be due to collapse of the cerebral capillaries In discussing the first of these two propositions, they cite a number of German authors who advocate the conception that asphyxia is due to lowered oxygen content of the blood These observers have inadvertently fallen into the error of assuming that the absence of cyanosis is indicative of the absence of anoxemia That the two symptoms are not necessarily synonymous has been amply demonstrated [13] In these cases, because cyanosis does not occur, it cannot be con-

cluded that anoxemia is not present Furthermore, the very important influence of respiratory and cardiac failure as the means of prolonging and intensifying the local cerebral asphyxia has been underestimated

Discussing the second possible cause of cerebral damage, namely, as a toxic effect, these authors point out the results of the experiments of Gianotti and Vannotti,[14] who studied the effects of nitrous oxide on the cerebral capillaries of experimental animals (rabbits) It was found that while anesthesia was being inducted, there was a contraction of the entire capillary system which was followed by dilatation as soon as anesthesia was established In other words, cerebral congestion followed nitrous oxide anesthesia This observation seems to be in accord with the findings at autopsy in individuals who die within a certain interval following nitrous oxide anesthesia In these cases the cerebrum is found to be markedly congested, both grossly and microscopically This conclusion is also supported by the fact that the brain bulges through any operative defect in the skull in patients under nitrous oxide anesthesia, a situation which is relieved by the administration of oxygen This congestion is naturally followed by a slowing of the blood current Gianotti and Vannotti did not find a collapse of the smaller blood vessels nor did a complete stasis result This temporary slowing of the blood current was immediately counteracted by administration of oxygen They emphasized the difference between nitrous oxide-oxygen anesthesia and nitrogen-oxygen asphyxia in which there is a collapse of the blood vessels and spaces Lowenberg, Waggoner and Zbinden conclude therefrom that, since there is no collapse of blood vessels, the cortical damage cannot be due to asphyxia but to some toxic action of nitrous oxide

Significance of Cerebral Changes Following Nitrous Oxide Anesthesia — A survey of the changes in the brain following delayed exitus after nitrous oxide anesthesia together with their possible significance is considered In cases with shorter survival periods, the earliest evidence of damage is found about the pericellular spaces of the pyramidal cells of the cerebral cortex The nerve cells in the area affected undergo acute alterations and the surrounding interstitial tissue are found to be vacuolated (Fig 1) Involving only a small group of cells, these areas may be so limited in extent as to escape the notice of a casual observer Only when these areas attain sufficient size to produce a pale area (*Herde*) in the cortex on stained section do they become evident with lower power magnification (Fig 2)

Is this finding indicative of a narcotic or an asphyxial action? It is known that narcotics exert a specific effect on the nerve cells resulting ultimately in morphologic alterations in these cells In severe cases of poisoning, a second effect may be evident, one which is due to alteration of the endothelium of the blood vessels, permitting an escape of red cells into the perivascular space (ring hemorrhage) There is, however, no direct action of narcotics on nerve fibers or interstitial elements On the other hand, any or all structures seriously affected by asphyxia undergo morphologic change Insofar as the brain is concerned, infarctions consequent to occlusion of a local blood vessel are classical examples of asphyxia On microscopic examination of an infarcted area, we find that both the nerve cells and interstitial structures are definitely injured

Judging from what is known about the effect of narcotics on one hand and of vascular occlusion on the other, we must, therefore, conclude that these local minor alterations in the cortex are more likely the result of asphyxia rather than of narcosis

Attention should now be given to the next most serious lesion of the brain, namely, patchy or spotty necrosis (Fig 3) Are these lesions an evidence of narcosis or of asphyxia? Gildea and Cobb[15] have shown that similar areas are to be found in the cortex after temporary ligation of the large vessels supplying the brain These experimental results are reproduced remarkably well in the patients who survive for a sufficient interval following nitrous oxide anesthesia

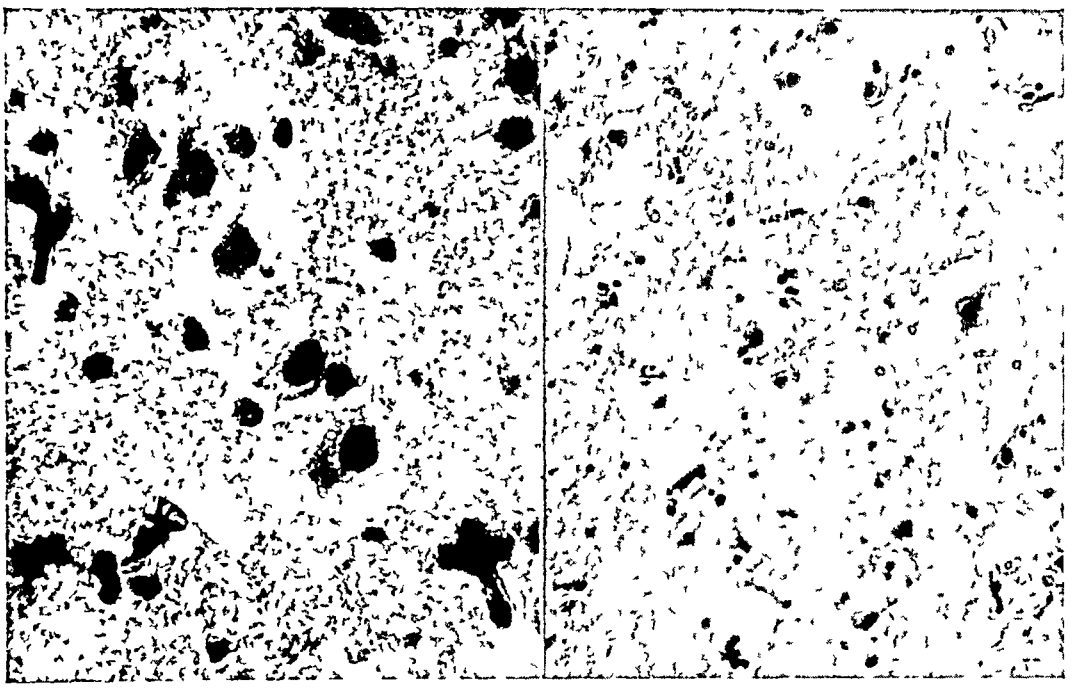


Fig 1—Early changes in the cerebral cortex Enlarged pericellular spaces and vacuolization of the surrounding interstitial tissue and nerve cells (H & E ×620)

Fig 2—Area of destruction showing enlarged pericellular spaces and vacuolization of the interstitial tissues The margin of the area is clearly defined (H & E ×250)

This fact would strongly indicate that this lesion, found characteristically after nitrous oxide anesthesia, is essentially an effect of asphyxia

By carrying the analogy one step further, it is found that these areas of destruction or spotty necrosis tend to occur in the vicinity of blood vessels (Fig 4) The blood vessels in these areas of devastation are often found to be dilated as compared to those in undamaged areas This dilatation of the blood vessels which is probably an effect of nitrous oxide, is followed by a slowing of the blood stream The amount of oxygen reaching any particular part is, therefore, definitely reduced (stagnation) This seems to be a conclusive argument that focal necrosis is not a narcotic effect, for stagnation would mean that *less* nitrous oxide would reach the affected area As final proof against this conception, is the fact that narcotics are not known to produce focal areas of necrosis in the cerebral gray matter

Turning now from these relatively minor alterations, we examine the more serious and profound lesions sometimes observed in these cases In patients

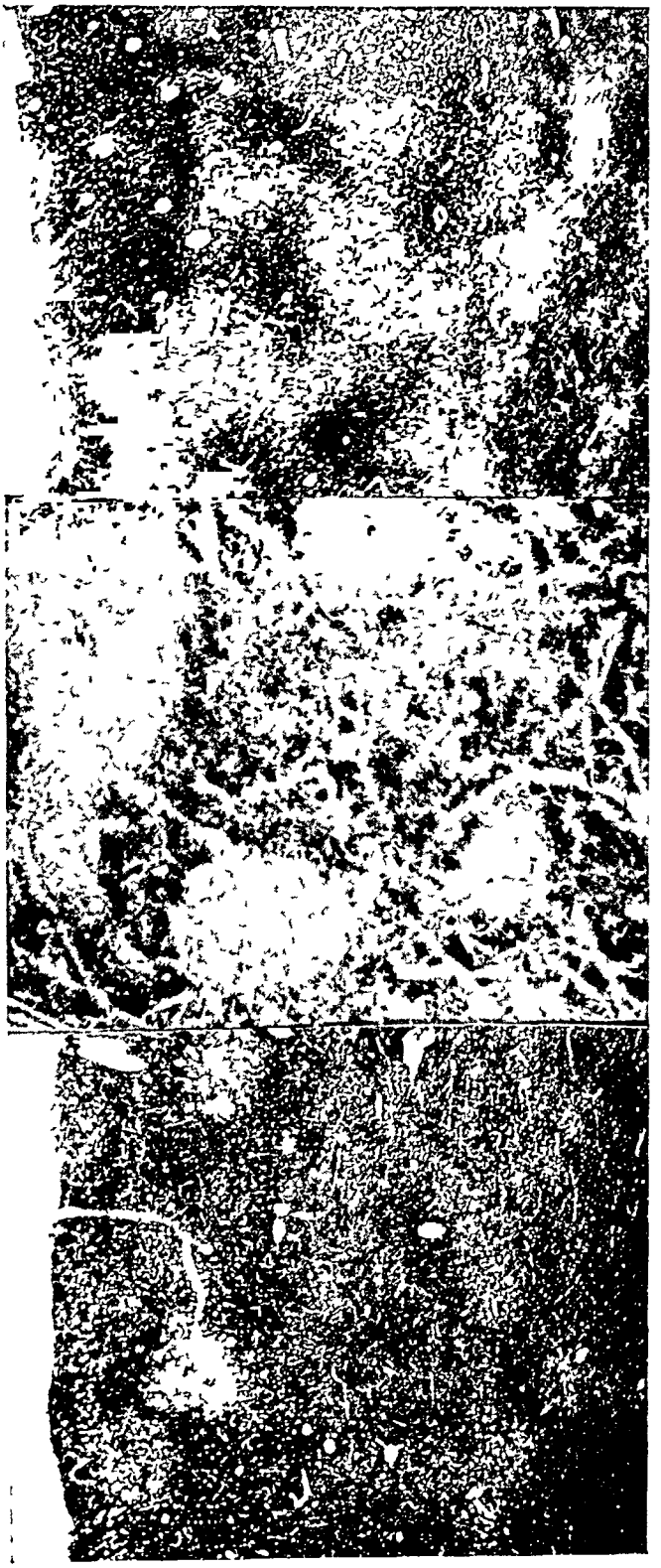


Fig 3.—Isolated areas of necrosis in the cerebral cortex. Note relationship of one area to the local blood vessel (Cajal reduced silver preparation × 22)

Fig 4.—Areas of necrosis about the dilated blood vessels in the lenticular nucleus (H & E × 50)

Fig 5.—Fusion of areas of destruction in a more advanced lesion (Cajal's reduced silver preparation × 22)

who survive for a sufficiently long interval following cardiorespiratory failure under nitrous oxide anesthesia, more or less complete localized destruction of the cortex may occur (Case 9 of author's series with survival for 26 days) (Fig 6) The lenticular nucleus, particularly the globus pallidus, are also seriously damaged Does the extent and distribution of these lesions indicate whether this effect is a narcotic or an asphyxial one? In the first place, there is no narcotic which is known to produce so extensive a lesion For example,



FIG 6.—Subtotal destruction of the visual cortex Survival period 26 days (Cajal's reduced silver preparation × 22)

severe morphine poisoning will cause injury to individual nerve cells as well as result in petechial hemorrhages throughout the brain, particularly in the white matter Following nitrous oxide asphyxia, petechial hemorrhages are the exception rather than the rule Furthermore, destruction of the lenticular nuclei is a more or less classic pathologic manifestation of asphyxia from almost any cause, such as carbon monoxide poisoning which also provokes an anoxic anoxemia

Finally, the irregular distribution of these areas of destruction and the variability of severity of the lesion in various portions of the cortex is not typical of narcotic poisoning in which the effects are more or less diffuse and uniform There is no known narcotic, for example, which has a predilection for the visual area of the cortex, while this is not uncommon following nitrous oxide anesthesia One must conclude again that on the basis of the severity and distribution of the lesions, the pathologic situation is more characteristic of asphyxia than of narcosis

Discussion —Space does not permit a complete consideration of the possible predisposing factors of the clinical manifestations present in these cases These have been quite adequately discussed in the author's original study [1 2] A few clinical points will serve to emphasize certain facts which are pertinent

In the first place, it is necessary to reemphasize the important physiologic fact that the absence of cyanosis does not mean an absence of asphyxia, since the one may occur without the other Furthermore, it is quite obvious from the clinical behavior of these cases that the mechanism of asphyxia must be a variable one In some instances, it is a prolonged and gradually accumulative effect In most cases, however, it is abruptly precipitated by sudden respiratory and cardiac failure, possibly incident to a depressant action of the gas on the vital centers or at times to the development of some intercurrent lesion (such as pulmonary embolism) It is to these cases with prolonged respiratory and cardiac failure that particular attention must be given

Without doubt, the major factor in the production of cerebral damage in these cases is not so much due to the presence of nitrous oxide itself, but rather to the failure of circulation in the brain during this interval of cardiac failure The blood, already poor in available oxygen, soon becomes depleted of this gas, and since no additional oxygen is supplied owing to failure of circulation, the destructive effects of anoxemia take place almost immediately It is doubtless during this interval that the cerebral damage occurs The most severe effects are evident about vessels which happen to be dilated at the moment, as indicated by the perivascular location of the areas of necrosis Stagnation is, therefore, probably the important factor which ultimately designates the location of the areas of necrosis Cortical damage is due, therefore, not so much to the presence of nitrous oxide, which is probably diffused proportionately throughout the blood stream, as it is to the failure of respiration and circulation The cortex does not get an adequate supply of oxygen and permanent damage results

CONCLUSIONS

The peculiar damage to the cerebral cortex and lenticular nucleus occurring in most instances after serious cardiorespiratory failure under nitrous oxide anesthesia, is probably the result of asphyxia and is not due to toxic narcotic action of the gas This seems to be evident by the fact that the earliest effect is observed in the interstitial tissue about the pericellular spaces as well as in the nerve cell itself, which is characteristic of asphyxia and not of narcosis Furthermore, in the areas of patchy necrosis, the findings are those characteristic of oxygen want, similar to those produced experimentally by temporary ligation of the larger arteries of the brain These areas of necrosis are not observed after poisoning with narcotics The extent and distribution of areas of severe necrosis in patients with longer survival periods are likewise not characteristic of any known narcotic Degeneration of the lenticular nucleus, on the other hand, is a common effect of asphyxia as seen in carbon monoxide poisoning

These alterations are probably the result of an anoxic anoxemia, incident

to the lowered oxygen content and tension in the blood, an accompaniment of nitrous oxide anesthesia When there is a sudden failure of respiration and cardiac action, the reduced amount of available oxygen is promptly used up and since no additional amount of oxygen is supplied, the brain suffers from the lethal effects of asphyxia The localization of the areas of focal necrosis seems to be dependent upon dilatation of the vessel with consequent stagnation Why all vessels are not coincidentally affected is not known

One may conclude, therefore, that the cerebral damage is a direct result of asphyxia, even though at times the cessation of respiration and cardiac action may be due to a depressant (narcotic) action of the gas on the vital centers In some of these cases, however, cardiorespiratory failure is due, not to the narcotic effect of the gas but rather to the development of some intercurrent lesion such as pulmonary embolism In cases without cardiorespiratory failure, cerebral damage is probably the result of prolonged accumulative anoxemia of a dangerous degree, due to inherent predisposing factors in the patient (alcoholism), to defects in the apparatus, to impurities in the gas or perhaps at times to improper administration of the anesthetic

REFERENCES

[1] Courville, C B Asphyxia as a Consequence of Nitrous Oxide Anesthesia Medicine, 15, 129, 1936

[2] Courville, C B Lenticular Syndrome Following Nitrous Oxide Narcosis Bull Los Angeles Neurol Soc, 1, 30, 1936

[3] Batten, C T, and Courville, C B Psychosis Following Nitrous Oxide Anesthesia (To be published)

[4] Lowenberg, K, Waggoner, R, and Zbinden, Th Destruction of the Cerebral Cortex Following Nitrous Oxide-Oxygen Anesthesia ANNALS OF SURGERY, 104, 801, November, 1936

[5] Bert, P Sur la possibilite d'obtenir, à l'aide du protoxyde d'azote, une insensibilite de longue duree, et sur l'innocuite de cet anesthesique Compte rend de l'Acad des Sci, 87, 728–730, 1878, Anesthesie prolongee obtenue par le protoxyde d'azote à la pression normale *Ibid*, 96, 1271–1274, 1883

[6] Martin, C Sur l'anesthesie prolongee et continue par le melange de protoxyde d'azote et d'oxygene sous pression (methode Paul Bert) Compte rend de l'Acad des Sci, 106, 290–291, 1888

[7] Hewitt, F Death under Nitrous Oxide Lancet, 1, 1053–1054, April 15, 1899

[8] Leake, C D, and Hertzmann, A B Blood Reaction in Ethylene and Nitrous Oxide Anesthesia J A M A, 82, 1162–1165, April 12, 1924

[9] Greene, C, and Associates The Distribution of Nitrous Oxide and Oxygen in the Blood of Dogs during Gas Anesthesia Arch Int Med, 35, 371–379, March, 1925

[10] Brown, W E, Lucas, G H W, and Henderson, V E The Anesthetic Value of Nitrous Oxide under Pressure Jour Pharm and Exper Therap, 31, 269–289, 1927

[11] Macklin, A H The Asphyxial Element in Gas-Oxygen Anesthesia Lancet, 2, 897–901, October 24, 1931

[12] Cushney, A P A Textbook of Pharmacology and Therapeutics, 9th ed Lea & Febiger, Philadelphia and New York, pp 240–245, 1928

[13] Lundsgaard, C, and van Slyke, D D Cyanosis Medicine, 2, 1, February, 1923

[14] Gianotti, M, and Vannotti, A Capillaroskopische Untersuchungen wahrend der Narkose Ztschr f d ges exper Med, 82, 240, 1932

[15] Gildea, E F, and Cobb, S The Effects of Anemia on the Cerebral Cortex of the Cat Arch Neurol and Psychiat, 23, 876–903, May, 1930

GENERALIZED LYMPHOGRANULOMA INGUINALE

THEODORE P EBERHARD, M D
NEW YORK, N Y

FROM THE SURGICAL PATHOLOGY LABORATORY OF THE COLLEGE OF PHYSICIANS AND SURGEONS, COLUMBIA UNIVERSITY, AND THE DEPARTMENT OF SURGERY PRESBYTERIAN HOSPITAL, NEW YORK CITY

LYMPHOGRANULOMA inguinale was so named by Durand, Nicolas and Favre[17] in 1913, because they believed that its lesions were limited to the genitalia and inguinal lymph nodes Today it is certain that that conception is incorrect, but it is equally certain that the complete picture of the disease is not yet known It is even possible, as has been suggested by Coutts,[11 12] Martin and Bacon,[35] and others, that there are really two diseases included in this classification, though, so far, there has been no proof of their contentions The purpose of this paper is to emphasize some aspects of this disease which have received but little attention in the American literature

The diagnosis of lymphogranuloma inguinale demands both its own laboratory and clinical confirmation and the exclusion of other diseases, which may in part account for the late recognition of it as an entity Neither the clinical picture, the histology, nor the Frei test can be depended upon alone Thus, although one form of "The Venereal Disease," described by John Hunter[27] in 1786, agrees completely with the usual inguinal form of lymphogranuloma inguinale, nevertheless, those cases may quite well have been either tuberculosis or syphilis Throughout the nineteenth century there were reports of cases of "climatic bubo," many of which are now supposed to have been lymphogranuloma inguinale, but for which there is no proof (Chassaignac,[7] Trousseau,[50] Nelaton,[37] and Klotz[29]) Even after Nicolas and Favre's[17] detailed description, and after the development of methods for the laboratory identification of syphilis, tuberculosis, chancroid, Hodgkin's disease, granuloma inguinale, and plague, the diagnosis was still largely that most unsatisfactory sort, the diagnosis by exclusion, and it remained so until 1925, when Frei[19] published his diagnostic skin test Likewise, the concept of the disease remained necessarily closely limited to the one originally outlined 12 years before

Ravault and Rabeau,[43] in 1922, raised the question of possible generalization after noticing that some of their patients showed fever, malaise, and transient positive Wassermann reactions, but it was not until 1928 that Frei and Koeppel[20] demonstrated the extension of the disease outside of lymph nodes into the rectal wall and perineal soft tissues Later in the same year Bergstrand[1] published the first conclusive case of widespread lymphoid involvement, confirmed by biopsies and repeated Frei tests

Since then the story of lymphogranuloma inguinale has been one of ever widening concepts In 1931, Buschke and Curth[4] reported a case of primary

Submitted for publication August 16, 1937

infection in the mouth, and, in 1932, Chevallier and Bernard[8] a purely cutaneous form of the disease Luján and Rotter's[34] instances of contact infection in children appeared the same year, as did the first comprehensive article in the American literature on the disease as a whole, that of DeWolf and Van Cleve[16] Frauchiger[18] reported his observations on polyarthritis in 1933 The next year Škorpil[48] reported a case of generalized lymphadenitis similar to our case, and Kitagawa[28] and Midana and Vercellino[36] published their observations on the changes in the central nervous system The recognized extent of the disease was further widened in 1935 by Reichle and Connor,[45] who reported a case of death from suppurative arthritis of the hip and interstitial nephritis of lymphogranulomatous origin The first report of death from a fulminating meningo-encephalitis was made by Rajam[42] in 1936, and primary granular conjunctivitis was also added to the list of possible manifestations by Levaditi and his associates[33] about the same time

The appended case report is the first instance, recognized in this clinic, in which there was marked involvement of the lymph nodes outside of the regional inguinal group, and is, I believe, the first reported in detail in this country, though there is mention of two such cases in the reports of Kornblith,[31] and Martin and Bacon[35]

Case Report—Unit History No 455929 An unmarried white male, age 45, presented himself at the Vanderbilt Clinic June 19, 1935, complaining of "swollen glands" of three weeks duration in the right groin The family and past histories were irrelevant He freely admitted frequent exposures with prostitutes but at first denied any form of sexual perversion Twenty months later he admitted that his last sexual relation before his illness had been coitus buccalis with a prostitute about one month before the onset of symptoms There had been no urethral discharge, and his first symptoms had been malaise, loss of appetite, pain in the right groin and in the lower back, and swelling of the right inguinal lymph nodes After two weeks the pain decreased but the mass in the right groin remained

Physical Examination revealed a small, thin man who did not appear acutely ill His abdomen was generally resistant but without spasm or palpable masses In the right inguinal region there was a 6 by 3 cm movable, nontender swelling with its long axis in the direction of the spermatic cord which could be felt above it It did not move with coughing or straining, and the skin over it was neither red nor hot No scars or ulcers were obvious on the penis Rectal examination was negative Temperature 100 4° F by mouth Opinion was divided as to whether the mass was a hernia or an inflammatory mass, and, as the patient did not appear to be in a serious condition, operation was deferred

Eleven days later he stated that on the previous evening he had been seized with violent generalized abdominal cramps These had continued throughout the night, becoming milder in the morning He had vomited once just before coming to the Clinic His abdomen was slightly distended, tympanitic, and generally tender to palpation The mass in the groin was possibly larger than when first seen but was not tender Roentgenologic examination of the abdomen failed to show any evidence of intestinal obstruction Temperature 102 2° F by mouth White blood cells, 12,200, differential P M N 72 per cent, S L 20 per cent, L L 8 per cent A preoperative diagnosis of inguinal adenitis was made, but with the possibility present of an incarcerated femoral hernia, the patient was operated upon at once An abscess was encountered containing thick yellow pus and necrotic tissue It was drained and packed with iodoform gauze and a silk tampon Smears

and cultures were negative Histologically, the tissue showed fat and fragments of lymph node in which there were foci of granular necrosis containing pyknotic nuclear remains and surrounded by zones of endothelioid cells generally arranged in radial fashion Many mononuclear macrophages and a few multinucleated giant cells resembling Langhans' cells were present No definite diagnosis was made

Following the operation, his symptoms remained practically unchanged but his temperature undulated in a three day cycle from a peak of 104 0° F per rectum to a low of 98 4° F On the days when his temperature was elevated he complained of some abdominal pain and slight dizziness The leukocytosis fell to 8,000 and the differential count remained the same Widal, *B melitensis, B abortus,* and Felix-Weil agglutinations, chest films for tuberculosis, blood Wassermann, and abdominal films for calcified nodes were all negative Finally two Frei tests were made and both were positive His condition gradually became worse He lost weight, had more severe abdominal pain, and retained the curious doughy feeling of his abdomen On July 18 an exploratory celiotomy was performed but nothing was found other than some light brown peritoneal fluid, slight injection of the serosal vessels of the ileum, and many enlarged nodes along the aorta and right iliac vessels The largest node measured 2 by 3 by 2 cm and was soft but not fluctuant It was removed and part of it used for guinea-pig inoculation and the rest kept for histologic study This tissue showed partial obliteration of the node architecture by hyperplasia of the lymphoid and endothelioid cells, but no definite foci of necrosis Postoperatively, his abdominal symptoms cleared up, the wound healed promptly, his temperature curve flattened out, and he was discharged six weeks after admission with his inguinal wound still draining The guinea-pig was negative for tuberculosis A small swelling appeared distal to the inguinal sinus early in September and this was incised and drained Sections of the tissue removed at the time showed small foci of necrosis which were not caseous but had blood vessels and collagen fibers preserved in them Rare multinucleated giant cells were seen and around some of the necrotic foci there were endothelioid cells Both sinuses finally closed early in October

On September 23, a small tender node appeared in the left anterior cervical region It was watched carefully, and suddenly, on October 2 and 3, it more than doubled its size, still without signs of acute inflammation The patient was admitted to the hospital and observed until October 16, during which time the mass slowly increased in size and became fluctuant at one focus Clinically it presented the characteristics of tuberculosis of the cervical lymph nodes An upper left neck dissection revealed several enlarged lymph nodes embedded in a mass of dense adherent fibrous tissue which extended much further forward than is usual in tuberculosis In the center of the main mass a small amount of thick, gelatinous, pale-yellow pus, quite unlike tuberculous pus, was found The wound was drained for 24 hours with a small Penrose tube and healed promptly Pathologic examination again showed the same histologic picture as the tissue from the inguinal nodes, and guinea-pig inoculations from the pus and tissue were negative for tuberculosis The patient was discharged on the seventh postoperative day, and after two weeks in a convalescent home returned to work During a 17 month follow-up he has remained in fairly good health, having only occasional periods of malaise In August 1936, he had an acute anterior cervical cellulitis which was treated privately It subsided quickly and was probably related to very bad teeth rather than to his original infection

Summary—A man with known exposure to possible venereal disease and with a positive Frei test developed, successively, inguinal lymph node enlargement, constitutional symptoms of muscle pains, abdominal pain, fever, malaise, dizziness, and loss of weight and appetite, abdominal and iliac lymph node enlargement, and finally cervical adenopathy

Etiology and Transmissability—Hellerstrom and Wassen[24 25] reported the passage of the infectious agent of lymphogranuloma inguinale through a

Berkefeld filter, in 1931, and thus established its identity as one of the filtrable viruses Their work was confirmed a few months later by Levaditi and his co-workers [42] The virus is apparently harbored both in the mouth and in the genitalia Coutts[9 10, 12 13] has even maintained, for several years, that it is primarily a mouth inhabitant and attributes the apparent increase in the incidence of the disease to a growth of sexual perversion resulting from economic stringencies and misguided efforts at birth control Once in the body, the virus is taken up by the cells of the reticulo-endothelial and lymphatic systems and distributed by them [12] The incubation period is unknown, having been reported as being as short as three days and as long as four months (Coutts,[9 12] Sézary,[46] Hellerstrom,[22] Nicolas and Favre,[17 38] and others) One infection appears to confer immunity for life, but no data have been presented yet, regarding how long or under what circumstances a patient remains infectious

Symptomatology *—The primary lesion is usually a tiny, soft, painless ulcer, though multiple ulcers and herpetiform eruptions have also been described It occurs most frequently on the glans or shaft of the penis, on the vulva, in the vagina, and in the mouth, less frequently the rectum, the peri-anal nodes, and the extremities may be directly infected There may or may not be a watery urethral or vaginal discharge for a few days The genital lesions heal spontaneously in a few days or weeks, while those in the mouth may become quite large and persist for months, probably because of infection of the lingual and pharyngeal lymphoid tissue In these cases there is what amounts to a coalescence of the primary lesion with secondary lymphoid tissue lesions In primary infection of the rectum also, the initial ulcers merge gradually with the permanent lesions With the ordinary genital infection, the patient is often quite unaware of the existence of any primary lesion, and, in over one-half of the cases, not even the tiny, white, stellate scar can be found on examination

More or less painful swelling of the regional lymph nodes and constitutional symptoms of malaise, anorexia, weight loss, joint and muscle pains, fever, headaches, and dizziness appear along with, or one to two weeks after, the primary lesion Nodular erythemata, peripapilledema, and tortuosity and congestion of the retinal vessels have also been described, but visual disturbances have never been noted These symptoms persist for two to four weeks and then subside, leaving the nodes swollen but painless In another two to four weeks, there is an exacerbation of symptoms The nodes enlarge still further, and the overlying skin becomes rugose, indurated, and congested, finally breaking down to form multiple sinuses which drain thick, stringy, yellow pus for months At the beginning of this phase there are often symptoms of involvement of the group of nodes next central to those originally

* The following section is a melange of observations in this clinic and data from the writings of Nicolas and Favre,[17 38] Coutts, *et al*,[9 10 11 12 13] DeWolf and Van Cleve,[16] Ravault, *et al*,[43 44] Camizares,[5] Curth,[14] David and Loring,[15] Kornblith,[30 31] Homma and Chaglassian,[20] and others

attacked, and the French writers consider symptoms of iliac node disease following inguinal adenopathy almost pathognomonic of lymphogranuloma inguinale After drainage has been established, the symptoms usually subside and the patient feels fairly well However, it is important to note that these symptoms may be extremely mild and may even escape the patient's attention entirely This is particularly true in those women whose primary lesion lies high in the vagina or in the cervix The inguinal nodes do not enlarge in these cases, for the lymphatic drainage from this region is to the deep pelvic nodes and perirectal tissues Hence, the first visit to the doctor may occur years after the original infection when symptoms of proctitis, elephantiasis of the vulva, condylomata multiple fistulae in ano, or most commonly, rectal stenosis, have appeared Occasionally a male is seen for the first time with these symptoms, and examination of the groins will reveal the scars of an inguinal infection contracted as along as 20 years before However, rectal infection in men is usually direct and the result of pederasty, and the patients come in the early stages complaining of constitutional symptoms and proctitis Examination reveals granular inflammation and multiple ulcerations of the rectal mucosa, without the fibrosis and stricture of the late cases

Any general discussion of the manifestations of the disease outside of the lymph drainage areas regional to the portal of entry is unsatisfactory because of our present lack of knowledge of these forms They seem to occur principally as complications of the acute phase of the more severe initial infections, but it is known that the disease may remain latent in local areas for many years and there may be as yet unrecognized lesions which develop far from the original site of infection years after that episode As has been stated, nearly every part of the body may be affected and the lesions may be fulminating, and even fatal, or they may be subacute or chronic In the lymph nodes, the disease seems to be self-limited and subsides after some months of drainage, while the extra-lymph node lesions are practically permanent The recognition of such manifestations will often be simply the result of exclusion of other diseases and a final recourse to the Frei test, although the presence of one of the more typical inguinal or oral infections will be a valuable clue in many cases About all that can really be said at present about these generalized forms is that any symptom complex of a granulomatous nature which does not clearly meet the criteria of one of the usually considered diagnoses should be thoroughly investigated for evidence of lymphogranuloma inguinale Only in this way will the full clinical picture of this disease be finally brought to light

Laboratory Data —The laboratory diagnosis of lymphogranuloma inguinale depends essentially upon the Frei test, an intracutaneous allergic response to an antigen prepared from the pus or diseased tissue of a patient with the disease As ordinarily carried out the test has had several shortcomings, the principal ones being lack of availability of the antigen for the general practitioner, variations in the potency of antigens, and an absence of foreign protein controls Many modifications of the original technic have been introduced in answer to these needs, the most important of which, aside from improved

preservation methods, has been the use of antigens prepared from infected mouse brains and controlled by similar preparations of normal mouse brains Grace and Suskind[21] have written extensively and enthusiastically of this method, while Strauss and Howard[49] have been equally vehement in condemning it Both human and mouse brain antigens are available commercially, and apparently both can give satisfactory results under the proper circumstances Hardly anyone, to-day, denies that the test is consistent and reliable, though there is still great disagreement over how much of a symptom complex can be safely attributed to lymphogranuloma inguinale on the basis of the Frei test As with many other diagnostic tests, single positives or negatives mean little or nothing, repeated tests with different antigens should always be made Furthermore, an unusual interrelationship with the Wassermann reaction must be guarded against in this disease

It seems to be definitely established that in the more acute phase of the disease the Wassermann reaction may become positive for short and often repeated periods To further complicate matters, many of these patients actually do have concomitant syphilis, as well as gonorrhea For these reasons, both tests must be repeated until consistent results are obtained and an interpretation then made on the basis of these results

Other technical adjuncts are of little value There is usually a leukocytosis of about 12,000 white blood cells per cm with the differential count remaining essentially unchanged Sometimes there will be a moderate relative increase in polymorphonuclear neutrophiles or a slight eosinophilia The spinal fluid may or may not show an increase in the pressure, cell count, protein, and globulin, and occasionally it will be possible to prepare a Frei antigen from it Finally, the intracerebral inoculation of white mice is beginning to assume the importance of the guinea-pig inoculation in tuberculosis, though the technic and interpretation are more difficult owing to the nonspecific histologic nature of the lesions

Microscopically, the typical lesions are small stellate foci of necrosis in which there are nuclear remains and fragments of connective tissue Around these foci are collections of lymphocytes, plasma cells, palisaded mononuclear macrophages, and endothelioid cells lying in a greater or less amount of dense, vascular connective tissue Giant cells are common and may resemble either Langhans' or Reed-Sternberg cells Unfortunately, this picture does not possess any unique characteristics, within its range of variation it may simulate tuberculosis, Hodgkin's disease, syphilis, or subacute pyogenic inflammation Most pathologists, to-day, feel that the greatest value of tissue examination in this disease lies in ruling out other diseases whose histology is specific[47, 31, 38]

Treatment—To date, there has been no satisfactory treatment devised for any form of the disease other than the more or less localized lymphadenopathies Radical surgical excision of the diseased nodes offers prompt and apparently permanent relief of the local symptoms, but care must be exercised not to remove too much of the lymphatic bed lest progressive occlusion of the lymphatics occur and lead to elephantiasis of the parts distal to the nodes

Innumerable biologic and chemical agents have been tried and there are enthusiasts and severe critics for each It must always be remembered that the disease undergoes spontaneous remissions and exacerbations and no favorable results can be attributed to any therapy unless they are obtained promptly and consistently and are lasting [5]

Prognosis—As long as the disease remains localized to the lymph nodes, the prognosis appears to be good Once it has spread beyond these boundaries, the lesions last for life, the patient may not die *of* the disease but will certainly die *with* it

SUMMARY

A case is presented of lymphogranuloma inguinale with severe constitutional symptoms and involvement of the inguinal, iliac, abdominal, and cervical lymph nodes

A brief review of the literature shows the steady growth of the conception of the extent of the disease

The symptomatology, laboratory findings, treatment, and prognosis of the disease are summarized No treatment has been definitely shown to have any permanent effect

An appeal is made for more general use of the Frei test in obscure disease syndromes

BIBLIOGRAPHY

[1] Bergstrand, H Can Lymphogranuloma Inguinale Manifest Itself as a Generalized Disease with Efflorescences in the Throat? Acta oto-laryng, 12, 461–467, 1928

[2] Bloom, D Lymphogranuloma Inguinale of the Tongue and Cervical Glands Arch Dermat and Syph, 28, 810–819, 1933

[3] Bory, L La lymphogranulome inguinal (ulcère simple adenogene des parties genitales) Progres med, 36, 565–569, 1921

[4] Buschke, A, and Curth, W Uber die Extragenitale Lokalization des Lymphogranuloma Inguinale Klin Wchnschr, 10, 1709–1711, 1931

[5] Canizares, D O Las formas ganglionaires atipicas de la enfermedad de Nicolas y Favre Acta derm-sifil, 28, 743, 1936, (abst Ann de dermat et syph, 7, 1085, 1936)

[6] Cardenas, M Sur le traitement de la lymphogranulomatose Acta derm-sifil, 28, 543, 1936, (abst Ann dermat et syph, 7, 795, 1936)

[7] Chassaignac, E Traite pratique de la suppurative et du drainage chirurgical, Paris, Masson et Cie, 1859, p 354 (Quoted by Bloom[2] and Martin and Bacon [24])

[8] Chevallier, P, and Bernard, J Forme cutanee puree de la maladie de Nicolas-Favre Bull Soc franç de dermat et syph, 39, 1351–1354, 1932

[9] Coutts, W E, and Banderas, B T Lymphogranulomatosis Venerea and Its Clinical Syndromes Urol and Cutan Rev, 38, 263–270, 1933

[10] Coutts, W E, Herrera, J M, and Perroni, F L Lymphogranulomatosis Venerea Am Jour Surg, 22, 96–105, 1933

[11] Coutts, W E Genito-ano-rectal Lymphogranulomatosis of the Male ANNALS OF SURGERY, 99, 188–194, 1934

[12] Coutts, W E Contribution to the Knowledge of Lymphogranulomatosis Venerea as a General Disease Brit Jour Trop Med and Hyg, 39, 13–19, 1936

[13] Coutts, W E, and Saez, E Lymphogranulomatose des ganglions du cou consecutive a des rapports linguovulvaires Ann d mal ven, 31, 24–31, 1936
[14] Curth, W Extragenital Infection with the Virus of Lymphogranuloma Inguinale Arch Dermat and Syph, 28, 376–380, 1933
[15] David, V C, and Loring, M Extragenital Lesions of Lymphogranuloma Inguinale J A M A, 106, 1875–1879, 1936
[16] DeWolf, H F, and Van Cleve, J V Lymphogranuloma Inguinale J A M A, 99, 1065–1071, 1932
[17] Durand, Nicolas, J, and Favre Lymphogranulomatose inguinale subaigue d'origine genitale probable, peut-etre venerienne Bull et mem Soc med d hôp de Paris, 35, 274–288, 1913
[18] Frauchiger, E Polyarthritis Lymphogranulomatosa Inguinalis Tarda Schweiz med Wchnschr, 63, 1207–1208, 1933
[19] Frei, W Eine Neue Hautreaktion bei "Lymphogranuloma Inguinale" Klin Wchnschr, 4, 2148–2149, 1925
[20] Frei, W, and Koeppel, A Ulcus Vulvae Chronicum Elephantiasticum (Esthiomene) und Sogenannte Syphilome Anorectal als Folgeerscheinungen der Lymphogranulomatosis Inguinalis Klin Wchnschr, 7, 2331–2336, 1928
[21] Grace, A W, and Suskind, F H Use of Lymphogranulomatous Mouse Brains for Diagnosis Arch Dermat and Syph, 34, 65–78, 1936
[22] Hellerstrom, S A Contribution to the Knowledge of Lymphogranuloma Inguinale Acta derm-venereol, Supp 1, 5–224, 1929
[23] Hellerstrom, S Experimentelle Untersuchungen uber Lymphogranuloma Inguinale Dermat Ztschr, 61, 395, 1931
[24] Hellerstrom, S, and Wassen, E Étude du virus de la lymphogranulomatose inguinale Compt rend Soc de biol, 106, 802–803, 1931
[25] Hellerstrom, S, and Wassen, E Weitere Untersuchungen uber die Natur des Lymphogranuloma Virus Ztschr f Immunitatsforsch u exper Therap, 73, 114–117, 1931
[26] Homma, H, and Chaglassian, N T Uber einen Fall von extragenitalen Lymphogranuloma inguinale bei einer Krankenpflegerin Wien klin Wchnschr, 48, 464–466, 1936
[27] Hunter, J A Treatise on the Venereal Disease Part V, "Of Bubo," p 230–261, Parry Hall, Philadelphia, 1791
[28] Kitagawa, K Lymphogranuloma Inguinale, Report of 37 Cases, Especially Clinical Findings of Cerebrospinal Fluid and Eye-grounds Jour Oriental Med, 20, 48–50, 1934 (Quoted by Coutts[11])
[29] Klotz, H G Uber die Entwicklung der Sogenannten strumoesen Bubonen und die Indikationen fur die Fruhzeitige Extirpation derselben Berl klin Wchnschr, 27, 132, 1890 (Quoted by Bloom[2])
[30] Kornblith, B A A Case of Lymphogranuloma Inguinale with Glandular Enlargement and Hepatosplenomegaly Jour Mt Sinai Hosp, N Y, 3, 24–28, 1936
[31] Kornblith, B A Observations on Lymphogranuloma Inguinale A Clinical-Pathological Study of 60 Cases, with Observations on the Histopathology of the Frei Test Surg, Gynec, and Obstet, 63, 99–109, 1936
[32] Levaditi, C, Ravaut, P, Lepine, and Schoen, Mlle R Sur les proprietes d'un virus pathogene pour le singe, present dans certains bubons veneriens de l'homme Compt rend Soc de biol, 106, 729–730, 1931
[33] Levaditi, C, Bollack, J, Basch, G, and Desvignes, P Conjonctivite avec adenopathie due au virus de la maladie de Nicolas-Favre (Lymphogranulomatose a localization oculaire) Bull Soc franç de dermat et syph, 43, 1238–1243, 1936
[34] Lujan, M, and Rotter, W Lymphogranuloma bei Kindern Klin Wchnschr, 11, 1387, 1932
[35] Martin, C F, and Bacon, H E Preliminary Report of 136 Cases of Lymphogranuloma Inguinale Internat Clin, 4, 250–293, 1935

[36] Midana, A, and Vercellino, L Les alterations du systeme nerveux central de l'homme dans la poradenite inguinale Bull Soc franç de derm et syph, 41, 161–165, 1934
[37] Nelaton, A De l'adenite inguinale subaigue simple a foyer purulents intraganglionnaires Semana med, 10, 402, 1890 (Quoted by Bloom[2] and others)
[38] Nicolas, Favre, *et al* Poradenite inguinale, *etc* A Symposium J med franç, 24, 405–434, 1935
[39] Nicolau, S Lesions cutanees lymphogranulomatoses chez une femme atteignt du syndrôme elephantiasique vulvo-ano-rectal Ann de dermat et syph, 5, 1–14, 1934
[40] Nicolau, S Lymphogranulomatose subaigue Ann de dermat et syph, 7, 267–268, 1936
[41] Prats, F G Contribucion al estudio de la linfogranulomatosis inguinal subaguda (101 casos) Rev argent de derm-sifil, 19, 196, 1935, (abst Ann de dermat et syph, 7, 409, 1936)
[42] Rajam, R V Report of a Fatal Case of Lymphogranuloma Inguinale from Meningoencephalitis Brit Jour Ven Dis, 12, 237–241, 1936
[43] Ravault, P, and Rabeau Reaction de Bordet-Wassermann passagerement positive et oscillante au cours de l'affection dite lymphogranulomatose inguinale subaigue des ganglions de l'aine Ann de dermat et syph, 3, 80–86, 1922
[44] Ravault, Boulin, and Rabeau Étude sur la poradeno-lymphite ou poradeno-lymphite suppuree benigne a forme septicemique, ou lymphogranulomatose inguinale subaigue de Nicolas et Favre Ann de dermat et syph, 5, 463–512, 1924
[45] Reichle, H S, and Connor, W H Lymphogranuloma Inguinale Report of a Case with Involvement of Retroperitoneal Lymph Nodes and Probable Involvement of the Hip Joint, Adrenals and Kidneys, with Autopsy Arch Dermat and Syph, 32, 196–203, 1935
[46] Sezary In discussion of Levaditi, *et al*[33]
[47] Sinard, L C L'anatomie pathologique de la maladie de Nicolas-Favre Union med du Canada, 65, 129–131, 1936
[48] Škorpil, F Lymphogranuloma inguinale mit seltener Komplikation čas lek česk, p 157–159, 1934, (abst Zentralbl f Hautkrankh, 48, 739, 1934)
[49] Strauss, M J, and Howard, M E The Frei Test Experiences with Antigens made from Mouse Brains J A M A, 106, 517–520, 1936
[50] Trousseau, A De l'adenie Clinique med de l'Hotel-Dieu-de-Paris, 2nd ed, 1865, 3, 581 (Quoted by Kornblith[31])

PILONIDAL SINUS

MATTHEW MCKIRDIE, M D

IOWA CITY, IOWA

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF IOWA, IOWA CITY, IOWA

THE clinical entity which has come to be known most widely by the term pilonidal sinus is regarded by many physicians and surgeons as a minor surgical condition a furuncle of the sacrococcygeal region which is incised, drained, and all too frequently forgotten It is described in the text-books of surgery as a minor surgical procedure and yet if we consider the percentage of recurrences as compared with many of the so-called major surgical operations and the results obtained from the present form of treatment, it would merit more consideration than has been accorded it in the past The frequency of recurrence with its accompanying annoying symptoms of pain and discharge, together with the economic losses resulting from complete or semi-invalidism for variable periods up to two months or more, makes this condition a thorn in the flesh to doctor and patient alike

The lesion has been described in the literature of the early nineteenth century, but it was not clearly differentiated until Warren,[1] in 1867, made the first thorough description, and Hodges,[2] in 1880, contributed the descriptive term "pilonidal," meaning nest of hair We have subsequently noted that hair is found in less than half the cases, but this term, because of wide usage, has taken precedence over more anatomically descriptive terms such as sacrococcygeal sinus or coccygeal fistula Much of the early investigative work has been done by Europeans (Tourneaux, Oehlecker, Lannelongue and others) Mallory,[4] in 1898, in this country, contributed a study of the caudal end of the embryo with this structure in mind Later clinicians (Stone,[5] Rogers,[6] Hall,[7] Fox[8] and Gage[9]) have added to the accumulated knowledge of the past In spite of this, the last word on the etiology and successful treatment has not been said It remains for the future to decide the relative merits of newer methods of treatment as compared with those previously accepted, unsatisfactory though they may be

Incidence—The present communication is an attempt to present some of the essential and significant factors in the causation, pathology and treatment of pilonidal sinus as revealed in our material and in that presented in past and current literature In a period of 11 years (1925–1936) we have seen 113 cases of pilonidal sinus in 96 patients Of this number 84 patients were operated upon 101 times Nine of the 84 were operated upon 25 times

The frequency with which pilonidal sinus occurs can best be appreciated by briefly presenting its occurrence as revealed by statistical study in reports obtained from clinic and hospital groups It should be made clear, however,

Submitted for publication August 16, 1937

that in the figures cited, the authors list as pilonidal sinus the so-called "sacral dimple" which is found in the new-born and which is considered a potential source of the pilonidal sinus as it is later recognized clinically, when it presents a well differentiated, infected tract Table I(A) shows the fairly high incidence of defects in the sacrococcygeal region of children and adults However, all of these individuals who show a defect in early and later years do not have a sinus tract, as illustrated in the occurrence of pilonidal sinus in only 3 to 4 per cent of the patients examined The second part of Table I(B) shows the ratio of occurrence in general clinic and hospital admissions Familial tendencies and the importance of trauma in the occurrence of pilonidal sinus will find as many adherents as opponents Some series show a com-

TABLE I[6 7 12]

(A) OCCURRENCE OF SACROCOCCYGEAL DEFECTS

20–25 per cent of all children
33⅓ per cent of 300 consecutive births
39 per cent in 85 children under 4 years
23 per cent of all patients examined
20–30 per cent of all patients examined
3 per cent of adults examined have a true sinus

(B) INCIDENCE OF PILONIDAL SINUS

30 cases in 19,000 patients	1 600
30 cases in 19,000 patients	1 600
7 cases in 15,000 patients	1 2,143
288 cases in 481,384 patients	1 1,683
96 cases in 149,913 patients	1 1,561*

* Author's statistics

paratively high incidence of familial occurrences, but in our series there were only five patients who reported a similar condition in an immediate member of their family Two brothers are included in our series Nineteen out of 96 patients list trauma as a factor and mention falls, kicks, riding on tractors, *etc*, as the exciting agent Sedentary occupations are reported as predisposing conditions, and students, office workers and others of sedentary habits have been cited as examples Other authors disagree with this observation and state that the type of individual is more significant This includes the heavy, obese, hypopituitary type where the skin glands are overactive and infection is frequent and persistent irrespective of the habits or work of the individual

Age, Race and *Sex* reveal several noteworthy points and also leave unanswered several questions Although the sacral dimple is very frequently seen in the new-born, the active, inflammatory, symptom-producing period of the pilonidal sinus is found in the third and fourth decades of life That it persists into the later years of a man's life can be shown, but its first flare-up usually occurs during the latter part of the second to the early part of the fourth decade The youngest patient operated upon was eight years old, the oldest 57, average 27 3 years Other authors place the average age in the early twenties Ferguson[10] (21–25), Rogers[6] (25), Smiley[11] (18–28) Of

the 96 patients observed, the peak appeared in the third decade when 55 patients, with a diagnosis of pilonidal sinus, in this age group were seen in the clinic The first and last two ten year periods were about equal, although the duration of symptoms in those over 50 goes back 10 to 20 and even 35 years

The occurrence, with regard to sex, is predominantly on the male side Out of 96 patients 78 were males and 18 were females, a ratio of 4 1 The findings of other authors confirm this sex ratio

All our patients were of the Caucasian race, and many reports state that this condition is confined solely to this race The literature reveals, however, that the Negro is also afflicted, although to a much less degree Breidenbach and Wilson[12] report three cases in their series, while Smiley,[11] and Fansler and Anderson[13] record one each No reports have mentioned the occurrence of the lesion in the yellow, brown or red races It opens an interesting field for speculation as to whether this is due to surveys being confined to the white race or to developmental or environmental factors being paramount in the production of pilonidal sinus

Etiology—The correct treatment of pilonidal sinus should, and must, rest on a clear conception of the factors responsible for its formation On one point all authors are agreed That it is of congenital origin Beyond this, opinion is divided into two principal schools Those who believe that it is due to an infolding of the epithelial layers of the skin, and those who assert that it is a remnant of the neurenteric canal The proponents of these theories include men well known in both clinical and investigative fields (Lannelongue, Oehlecker, Bland-Sutton, Mallory, Ewing, Streeter, Stone and many others) Of the recent investigators, Fox,[8] and Gage,[9] each representing an opposing view and each having arrived at his conclusions by the study of serial sections of the human fetus, present the most recent available evidence

Fox found ectodermal invaginations in the three and one-half month fetus lying just cephalad to the anus These creases became pit-like in the five and one-half month fetus, and histologic sections showed that the epithelium was thicker in the areas of invagination As older specimens were observed, the ectodermal invaginations became deeper until shortly after viability (27½ weeks) it lay directly over the coccyx Regression began at 29½ weeks, and if these depressions persisted into postnatal life they formed the sacral dimple or sinus tract seen in the child or adult Stone[3] has suggested that this process may be a vestigial remnant of the gland found in birds which is used in oiling the feathers He has called it the "preen gland" It is located near the end of the spine, and is composed of several straight tubules which drain through a common duct lined with modified squamous epithelium Analogous glands are found in reptiles and mammals and are called sex glands They develop with maturity and may be regarded as secondary sex characteristics If the parallel is carried further these remnants may develop in the human with the onset of puberty, thus accounting for the prevalence of activity of the pilonidal sinus in the latter part of the second and third decades

Gage, as a result of his investigative work, believes that the true pilonidal

sinus is due to the persistence of the neurenteric or neural canal Normally in the caudal end of the embryo that portion of the neural canal which is formed by the union of the neural folds and which lies between the skin and coccygeal vertebrae is obliterated by cohesion of its walls Should this portion fail to become obliterated by cohesion, it will form a cavity which may be connected with the skin by one or more sinuses It may be entirely isolated from the remainder of the neural canal or it may be connected with it by a patent filum terminal The lining of the cystic cavity will retain the faculty of producing the primitive skin appendages—the hair follicle or shaft, and a rudimentary type of nervous tissue if a connection with the spinal canal remains Gage has been able to demonstrate both types of tissue in histologic sections taken from excised pilonidal sinuses

He believes that this is the origin of the true pilonidal sinus, and the sacral dimple is the result of an anterior pull on the overlying skin by the caudal ligament as the coccyx grows downward and curves anteriorly

From the foregoing discussion it becomes apparent that it will make some difference in the treatment, depending upon which source of origin is recognized According to Fox, a block dissection down to the sacrococcygeal fascia will remove all sinus elements, while if Gage's findings are accepted it may be necessary to strip the periosteum and even remove the coccyx

Symptomatology and Pathology—Grossly, the pilonidal sinus usually consists of a draining sinus which opens in the midline several centimeters cephalad to the anus The surrounding tissue is frequently acutely inflamed or chronically indurated A probe passed into the sinus tract leads cephalad and toward the sacrum Often the number of sinuses may vary considerably with the amount of infection, and there may be openings for several centimeters to either side of the midline The usual, uncomplicated pilonidal sinus consists of a single, midline sinus leading down to a cystic cavity lying in the subcutaneous tissue above the periosteum of the sacrococcygeal vertebrae Hair may be seen protruding from the sinus opening, but this is not a frequent finding when infection has been present any length of time In this case the squamous epithelium has been replaced by a chronic granulation tissue and the deeper tissues contain collections of lymphocytes, plasma cells, foreign body giant cells or groups or polymorphonuclear leukocytes Only 56 per cent of our cases showed hair follicles or shafts on gross or microscopic examination Masson[14] reported 35 per cent in 86 cases, and Owen[15] lists ten out of 40 cases

Bacteriologic studies were carried out on only eight cases, chiefly with pus from acutely inflamed, unopened cysts There was no growth on four cultures and the remaining four showed *Staphylococcus aureus* and *albus*, a gram-positive rod and diplococcus The number of sinuses varied from none to ten, the average being two Inflammatory reaction was present in well over 90 per cent of the cases

In two patients an extension of the pilonidal sinus was noted In one instance a dermoid cyst was found lying anterior to the coccyx and a second

tract extended up along the anterior surface of the sacrum to the promontory The coccyx was removed The secondary tract was diagnosed as a pilonidal sinus and histologic sections revealed rudimentary glial cells In the second case there appeared to be a cord extending from the pilonidal sinus into the periosteum of the sacrum It was decided that it was a vein and it was cut Follow-up revealed that the patient subsequently developed a recurrence Reports have been published in the literature of meningitis occurring in individuals with pilonidal sinuses [22] Opponents of the neurenteric theory state that these individuals have a spina bifida occulta and the lesion is located higher than the usual site of occurrence

The symptoms of pilonidal sinus are quite characteristic of inflammations elsewhere—pain, redness, heat, and swelling with an irritating, seropurulent discharge Drainage of the acutely inflamed cyst, whether by incision, trauma, or spontaneous rupture, gives relief from the pressure symptoms, but this is often followed by the aggravating, continuous or intermittent drainage which causes excoriation of the surrounding skin Subsidence may, and frequently does, occur with a remission of symptoms for variable periods of time In our series the symptoms ranged from one week to 35 years, with an average of six years Of 96 patients, 57 had received no previous treatment, although in many the cyst had ruptured spontaneously Of the remaining 38 who had received treatment, 34 had been incised, ten had had excision operations, in two the tract had been injected with a sclerosing solution and in one patient it had been curetted

Treatment—The incisional method is only palliative, useful merely in promoting drainage and subsidence of the acute inflammatory phase As a method of permanent relief, it has been discarded and the excision of the sinus tract and cyst is the generally accepted procedure at the present time The controversial points are chiefly around the amount of tissue or bone removed, the methods of closure and postoperative care Of the 101 cases operated upon, 87 were treated by excision, and it is this group that is particularly considered Before describing the methods of operating, three preoperative factors will be discussed briefly Skin preparation, anesthesia, and the use of dyes to visualize the sinus tract

The area in which the lesion is located is a fertile field for contamination from the gastro-intestinal tract, and perspiration and body heat increase the conditions favorable for bacterial growth Preparation of the skin should receive meticulous care prior to operation and during the period of wound healing Frequently the skin is excoriated for some distance around the sinus openings and operation is best delayed until this has been cleared up In our series the standard antiseptics such as iodine, picric acid and merthiolate have been used, the tendency being to employ the latter two in recent years Since gentian violet has been used successfully in cutaneous infections and in preparing the body surface for wide operative fields as in thoracic surgery, better preparation might be obtained by the use of this agent

The inhalation anesthetics have been used predominantly in this type of

operation, but during recent years there has been a growing tendency to use spinal[15] or local[7] infiltration, notwithstanding the fact that an infected field is being invaded Forty-three of our cases were anesthetized with ethylene, four with ether, eight with nitrous oxide, one with cyclopropane, two with spinal, and four with local novocain infiltration

Dyes and colored solutions have been used for years in the treatment of pilonidal sinus Most surgeons feel that injecting the tract with methylene blue facilitates removal and gives an added sense of assurance that the tract has been entirely eradicated Opposed to this view is a smaller group represented chiefly by Rogers and Hall,[7] who believe that the use of dye is dangerous and detrimental to complete excision because of the false sense of security which it gives Weeder,[16] believing that many recurrences are due to failure to follow the tract down to the periosteum and coccyx, advocates the use of a radiopaque solution, such as lipiodol, for visualization of the sinuses and possible connections with the sacrum or spinal canal Seventy-five out of 87 cases operated upon by the excision method in our series had the sinus tract injected with methylene blue, and it was recorded on the operative report whether or not dye-stained tissue was cut across Breidenbach and Wilson,[12] in their large series of cases (287), reported little difference in the cured cases, irrespective of the use of methylene blue

The excision method, as carried out in most clinics, utilizes a wide, elliptical incision which includes the tract, and a block dissection of the diseased tissue down to the sacrococcygeal fascia The defect may then be left open and packed, allowing the defect to granulate in, or the edges may be approximated with deep retention sutures and iodoform gauze packed between the wound edges The third method is primary closure with or without drainage Plastic procedures may be used, such as that described by Lahey[17] Methods other than excision have been advocated but have not been generally adopted Cutler and Zollinger[18] used a modified Carnoy's solution (chloroform, absolute alcohol, glacial acetic acid, ferric chloride) in various fistulae, sinuses and cerebellar cysts They laid open several pilonidal sinuses and cauterized the tract with the sclerosing solution Smiley[11] reported three cases, two of which were well at the end of six months Rogers and Hall[7] reported only one case treated in this manner and abandoned the method because of repeated sloughs and residual sinuses

Probably the most recent method is that described by Stanton,[19] in 1932, and applied by Rogers and Hall[7] to a series of 50 patients over an eight months' period The treatment is ambulatory, requires a very brief period of hospitalization, and the patient is followed in the clinic It consists of removing the sinus tract and a minimum of surrounding tissue, under local anesthesia, without sacrificing the overlying skin The electrocautery is used, the defect packed, and the diseased tissue which remains is removed on subsequent visits in the same manner No dyes are employed and hemostasis is controlled by packing and thromboplastin

Results—Tables II and III show the results obtained in a series of 87

cases treated by the excision method These operations were performed by 24 different surgeons Of the 87 cases operated upon, 61 were traced by letter or made a return visit to the clinic Of the number traced, 22 recurrences were noted, a recurrence percentage of 36 The average postoperative

TABLE II

METHOD OF TREATMENT

Total number of cases	101*
Excision method	87
Primary closure with no drainage	2
Primary closure with drainage	68
Partial closure over gauze pack	6
Wide open packing	11
Incision method	14
Total cases drained—excision and incision	99
Methylene blue injected into sinuses	74
Average postoperative days in hospital	14 2

* Although 113 cases were listed, 12 of these were in new-borns in which only a sacral dimple was present These cases were not considered as true pilonidal sinuses and have therefore not been included in the above tables

stay in the hospital was 14 2 days Of the 87 cases, 35 healed by primary and 52 by secondary intention A second operation was required for hemorrhage, excision of a secondary tract, skin grafting and the drainage of an abscess An appendicectomy, a herniotomy, and the drainage of a subdiaphragmatic abscess occurred in three patients while they were being hospitalized Hemorrhoids and fistulae were operated upon in several instances while the pilonidal sinus was being treated

TABLE III

RESULTS OF EXCISION METHOD AS REVEALED BY FOLLOW-UP

	Excision Primary Suture No Drainage	Excision Primary Suture With Drainage	Excision Partial Closure Gauze Pack	Excision Wide Open Packing	Total Cases
Number of operations	2	68	6	11	87
Number of follow-ups	0	45	5	11	61
Number of recurrences	0	14	1	7	22
Percentage of recurrences	0%	31%	20%	63%	36%

Table III shows the methods employed, with the number of operations performed by each method, and the number of cases with recurrence following the various procedures The majority of our cases were treated by excision, primary suture and drainage, but the highest percentage of recurrences occurred in those cases which were excised and packed wide open This method was used chiefly in cases which had been unsuccessfully operated upon

The percentage of recurrence in our series is higher than those reported by other authors who have written upon the results of the excision method

(Rogers and Hall—30 per cent (first series), Rogers and Hall—34 per cent (second series), Rogers and Hall[7]—0 per cent (third series), Brendenbach and Wilson[12]—23 per cent, Owen[15]—8 per cent, Cattell and Stoller[20]—23 per cent, Ferguson[10]—17 per cent, and Glenn[21]—28 percent)

Discussion—It is interesting to note that our figures compare more favorably with those reported in the first and second series of Rogers and Hall[7] These authors, at the completion of their first series, drew up a strict regimen by which all the patients in their second series were to be governed In spite of this, the percentage of recurrence was higher, and they sought another method by which the end-results would be improved and the period of hospitalization and loss of time from work would be reduced In the application of the method of Stanton,[19] previously described, the patients were not selected according to the severity of the condition, but were taken as they presented themselves namely, recurrences as well as new cases Of the 50 patients operated upon during an eight months' period, 29 were far enough along to judge the results In this group there were no recurrences and the average stay in the hospital was one day All the cases were operated upon under local anesthesia

Ferguson[10] has reported a series of pilonidal sinus cases in which he used local anesthesia, injected the sinus with methylene blue, and preserved as much of the skin and normal tissue as possible Closure was complete and without drainage The patient was placed on his back for an hour, in order to effect hemostasis, and was then able to continue his work without further loss of time The skin sutures were removed on the third day Twenty-four cases, thus treated, were followed for at least one year, with recurrence in but one instance In a previous series in which incision or excision and packing had been employed, Ferguson's recurrences varied from 50 to 90 per cent

Owen, in a series of 40 cases, had two recurrences Twenty-three, or 57 5 per cent, were treated by the excision and wide open packing method, the remaining 17 by excision and primary closure with drainage or partial packing

In reviewing the 22 cases in our series in which recurrence was noted, 14 had received previous treatment, approximately 65 per cent The highest percentage of recurrences occurred in those cases in which the defect was allowed to heal by wide open packing and granulation In many of these patients, in whom this method was used, there had been marked infection, and primary closure was thought to be inadvisable These wounds required frequent attention and the healing was tedious

Summary—(1) During a period of 11 years, 96 patients have been observed, with a condition which has been diagnosed as pilonidal sinus Several of the patients have been treated twice or oftener for a recurrence of the original condition, making a total of 113 instances in all

(2) Although many new-born children and infants show a dimpling or depression over the sacrococcygeal region, nevertheless, the presence of a

true sinus tract in adults is limited to about 3 or 4 per cent of the population Males show a considerable predominance in the incidence of this condition, and the age average falls chiefly in the third decade

(3) The theories of origin are confined chiefly to whether the cyst or sinus arises from the neurenteric canal or is the result of ectodermal invagination We believe that clinical and experimental evidence lends more support to the former theory

(4) The pathology and symptomatology in the average case are similar to those of a chronic inflammatory process which has undergone an acute phase with periods of chronicity and subsequent exacerbations

(5) Treatment consists essentially in the complete eradication of the sinus tract without the sacrifice of any more normal tissue than is necessary We believe that the injection of the sinus with methylene blue is conducive to a false sense of security and the needless sacrifice of normal tissue

(6) Recurrences are frequent and are due to several factors Failure to remove the sinus tract, operation for excision in the face of acute infection, poor hemostasis, and the presence of dead space with subsequent hemorrhage and infection

CONCLUSIONS

Our conclusions, in general, agree with those noted in the body of the paper However, there are several facts which are worthy of reiteration for the sake of emphasizing their importance in the treatment of pilonidal sinus

We believe that Gage presents the more embryologically correct explanation of the occurrence of the true pilonidal sinus and that his evidence fits in with the clinical findings The occurrence of cysts or sinuses which are not true pilonidal sinuses may be explained by the data presented by Oehlecker and Fox [8] A connection with the sacral and spinal canal may not always be demonstrable due to the obliteration of the connection which takes place In this instance the injection of lipiodol should be attempted in an effort to visualize the extent of the sinus tract and its relationship to the bony structures or the spinal canal The relationship of the sinus tract to the sacrococcygeal vertebrae will probably be found to be higher than it is at present thought, although it is doubtful whether it will require the removal of the coccyx in 30 per cent of the cases, as has been suggested [16]

The use of a dye is of questionable value and depends upon several factors If given with sufficient force to penetrate the entire tract, it may burst through and stain the tissues, as has been demonstrated on histologic sections [7] On the other hand, if insufficient pressure is used, the dye will not penetrate the smaller radicles and a false sense of security will be given The value of the dye has been overestimated and its disadvantages minimized

The essential factor in recurrence, so far as we have observed it, is the presence of infection in the tissue and the formation of sinuses arising out of this infected tissue We are not discounting the remnants of the sinus tract which may remain, but feel that this fact has been emphasized to the

point where too large amounts of normal tissue have been removed, with the opportunity for bleeding, infection and the development of dead space The first step in the reduction of this factor is the recognition of the need to postpone operation where acute infection is present The principle is observed elsewhere in the body and should be particularly true in this region Incision is the method of choice under these circumstances Skin preparations should be rigidly observed and the use of gentian violet has been suggested as a more satisfactory means of securing this result as evidenced by its success in cutaneous infections elsewhere

In their desire to completely excise the tract, many operators remove too large a block of tissue It has been shown embryologically and by pathologic examination that the majority of sinuses are in the midline A small block of tissue will remove the pathologic tissue without exposing the surrounding areas to contamination, and the lateral tracts which are found are very frequently the result of infection burrowing to the surface

We believe that the wound should be closed if the surgeon feels reasonably sure that it is not grossly infected Hemostasis and obliteration of dead space should be effected If drains are used they should be inserted at the upper angle or between the stitches, not from the lower angle If the wound is grossly infected then wide open packing is the method of choice, providing the postoperative care can be carefully given and closely followed The repeated cautery and packing method advocated by Rogers and Hall[7] cannot be used in this clinic because of our inability to follow the patient as closely as the method requires

The use of pressure over the sacrococcygeal region for one hour postoperative, as suggested and practiced by Ferguson,[10] is beneficial in securing hemostasis and obliterating dead space We believe that in many of the simpler types of pilonidal sinus it would promote faster healing, lessen the danger of infection, and materially reduce the period of hospitalization, by having the patient up on his feet sooner Strapping the buttocks together will take some of the tension off the sutures and will also prevent too free motion when walking

REFERENCES

[1] Warren, J M Surgical Observations, 192, Boston, 1867
[2] Hodges Quoted by Fox
[3] Stone, H B ANNALS OF SURGERY, 79, 410, 1924
[4] Mallory, F B Jour Med Sci, 262, March, 1892
[5] Stone, H B ANNALS OF SURGERY, 94, 317, 1931
[6] Rogers, H Surg, Gynec, and Obstet, 57, 803, 1933
[7] Rogers, H, and Hall, M G Arch Surg, 31, 742, 1935
[8] Fox, S L Surg, Gynec, and Obstet, 60, 137, 1935
[9] Gage, M Arch Surg, 31, 175, 1935
[10] Ferguson, L K ANNALS OF SURGERY, 101, 469, 1935
[11] Smiley, K E Amer Jour Surg, 27, 298, 1935
[12] Breidenbach, L, and Wilson, H L ANNALS OF SURGERY, 102, 455, 1935
[13] Fansler, W A, and Anderson, J K Minn Med, 17, 146, March, 1934

[14] Masson, J C Surg Clin N Amer, 15, Pt 2, 737, 1925
[15] Owen, H R Surg Clin N Amer, 14, 117, 1934
[16] Weeder, S D ANNALS OF SURGERY, 98, 385, 1933
[17] Lahey, F Surg, Gynec, and Obstet, 48, 109, 1929
[18] Cutler, E C, and Zollinger, R Am Jour Surg, 19, 411, 1933
[19] Stanton, F D Tr Am Coll Proct, 9, 69, 1932
[20] Cattell, R B, and Stoller, L W New England Jour Med, 206, 110, 1932
[21] Glenn, F New England Jour Med, 207, 544, 1932
[22] Ripley, W, and Thompson, D C Am Jour Dis Child, 36, 785, 1928
[23] Weinstein, M ANNALS OF SURGERY, 97, 80, 1933
[24] Ottenheimer, E T Am Jour Surg, 21, 120, 1933
[25] Colp, R Surg Clin N Amer, 9, 695, 1929
[26] Babcock, W W Surg Clin N Amer, 6, Pt 1, 42, 1926
[27] Christopher, F Minor Surgery, 1936

PILONIDAL SINUS

OBSERVATIONS ON ONE HUNDRED FORTY CASES TREATED BY CAUTERY EXCISION

HORATIO ROGERS, M D , AND RICHARD W DWIGHT, M D
BOSTON, MASS

FROM THE SURGICAL SERVICES OF THE MASSACHUSETTS GENERAL HOSPITAL BOSTON, MASS

THE purpose of this paper is to present the experience we have gained through treating a series of cases of pilonidal sinus by the method described by one of us,[1] in 1935, as "Cautery Excision" The present report comprises 140 unselected hospital cases, both new and "recurrent" In it no distinction between previously treated and untreated cases will be made, as no significant difference in their behavior under the present method of treatment has been observed The earliest excision was in July, 1934, and the latest in April, 1937 During this period, while the practice of hospitalizing patients with pilonidal sinus has been giving way to out-patient management, the ratio of male to female patients has increased from 2 1 in 1934 to 14 1 in 1937 Of the 140 patients, 102 were male and 38 female, or a ratio of practically 3 1

Two patients were Negroes, the rest white—a high Negro incidence in a clinic almost exclusively white

Ages at the time of treatment were chiefly in the latter part of the second decade and in the early part of the third, the youngest being age 15 and the oldest 42

Although the disease varied greatly in extent and severity, there was no case of extension into the neural canal, sacral hiatus, sacrococcygeal joint, or beneath the sacral aponeurosis No case of cancer associated with pilonidal sinus was encountered

Excision was not undertaken in the presence of acute abscesses These were drained by incision in the midline or by dilatation of a midline sinus-opening at least three weeks before excision was performed

As far as possible the same surgeon who performed the excision also took care of the dressings When this rule was disregarded the patient was likely to suffer Ninety-seven patients were treated entirely by the authors, 30 by members of the resident staff under our supervision, and 13 by other members of the visiting staff

All of the patients were ambulatory throughout their treatment except 14 whose excisions were accomplished under a general anesthetic, necessitating a brief period of hospitalization, usually 24 hours, and four who returned to the hospital for various complications

RATIONALE OF CAUTERY EXCISION —In attempting to evaluate the various

Submitted for publication December 4, 1937

methods of treating pilonidal sinus it should be clearly recognized that whether the condition be simple or complex, permanent cure depends on the fulfillment of only two major principles (1) Its cause, *i e*, hair, ectopic epithelium and infected scar tissue, must be removed, and (2) the resultant wound must heal solidly, *i e*, without dead space or infected scar tissue

The former of these two principles usually presents few difficulties and may be accomplished in a variety of ways Very radical block excisions, however, have been abandoned, as a better understanding of the morphology has shown them unnecessary,[2] and more careful follow-up has shown them too prone to fail of cure Various chemical and physical agents have been suggested to destroy the ectopic epithelial cells which constitute the congenital variation associated with the later development of pilonidal sinus These suggestions fail to take into account the possibility that the infected scar tissue present in every pilonidal sinus as a result of trauma and infection, rather than the ectopic epithelial cells, may be the actual cause of the sinus As a matter of fact, what evidence there is tends to show that ectopic epithelial elements alone usually do not cause sinuses If they did, we should expect that (a) As many females as males would have sinuses, since the congenital defect is not known to be dependent upon sex, (b) sinuses would uniformly appear in early life, having only a congenital cause, (c) complete excision of ectopic epithelial elements would always result in cure, and (d) ectopic epithelial cells would always be demonstrable in tissue excised for "recurrent pilonidal sinus" The facts are that (a) Males outnumber females at least three to one, (b) sinuses sometimes do not appear until age 50, (c) of 140 radical block excisions reported by one of us,[2] 30 per cent failed to cure the sinus, and (d) serial microscopic sections have shown ectopic epithelial elements in less than 10 per cent of "recurrent" sinuses[2]—the true figure being nearer 1 per cent, in our opinion On the other hand, the last two items of evidence are enough to prove that chronically infected scar tissue alone is quite capable of keeping a sinus draining Thus we believe that though cure cannot be expected unless all of the diseased tissue be excised, excision satisfies only one of the two essential principles

Granted that some sort of excision be necessary, the method of its accomplishment should be predicated upon the factors governing the healing of the resultant wound, that is, if these wounds will heal more safely by second intention than by first, there can be no point in using a technic the only recommendation of which is that it permits healing by first intention Many surgeons who would not think of courting failure by a primary closure of the wound still handicap themselves by performing a comparatively blind, bloody excision, when by the use of the proper cautery technic they could accomplish the same end more quickly, more accurately, more conservatively, and more easily in a bloodless field What, then, is the case for primary closure?

In the first place, primary closure often succeeds, in our experience about 50 per cent of such attempts (in selected cases) have resulted satisfactorily Secondly, a *successful* primary closure does away with the more or less pro-

longed course of dressings which are essential to the success of second intention healing—in other words, it is less irksome to the surgeon as well as the patient Granting, however, that first intention healing is desirable, it still does not follow that the best way for all pilonidal wounds to heal is by first intention

It has been our experience that failures due to defective wound healing outnumber those due to incomplete excision at least ten to one Few parts of the body are so exposed to bacterial contamination, minor trauma, and unavoidable muscular motion In common with other median raphes, the tissues in this region have a natural tendency to draw apart when longitudinally incised, leaving a good-sized cavity even though no tissue has been removed When one considers the fact that sepsis—chronic, acute, or both—is the factor which actually brings the pilonidal cyst to the attention of the patient as well as the surgeon, it becomes apparent that ordinary measures, which would succeed in other parts of the body, must frequently result in failure when applied to this type of lesion

Of course these unfavorable factors are present in varying combinations and degrees depending on the exact location and extent of the wound A wound made by the aseptic excision of a small, uninfected cyst overlying the upper coccyx, for example, might be carefully sutured with a fair expectation of primary union and solid healing But even here, hidden, dead space and postoperative contamination would cause an occasional failure We have twice seen persistent sinuses result from clean coccygectomies for painful coccyx, and Ferguson,[3] who has brought the technic of primary closure very near perfection, has had failures from these causes On the other hand, failure is to be expected from suturing a wound left by the excision of an extensive, infected sinus tract with openings near the anus In fact, we have seen many cases in which complete, conservative excision by sharp dissection would have been almost impossible because of lack of visibility, and suture without dead space resulting entirely impossible

In view, therefore, of the many obstacles to the healing of wounds in the coccygeal region, we are now satisfied that most pilonidal sinuses can best be excised by the cautery technic, the wounds kept packed and allowed to heal by second intention, and that regardless of the technic of excision, if constant observation of the healing wounds be omitted, either through neglect or as a consequence of primary suturing, the solid healing of even a simple wound must be largely a matter of chance

Technic of Cautery Excision—*Materials* "Post" cautery equipped with point No A 4

Four double hooks (or a small self-retaining rake retractor if no assistant is available)

Toothed tissue forceps

Tuberculin syringe equipped with a hypodermic needle

Five cubic centimeter syringe equipped with a hypodermic needle

Sixty cubic centimeters of a 1 per cent novocain solution containing 0 2 cc of 1–1000 adrenalin solution

Sterile gauze sponges

Sterile mastoid sponges ("Hibb's")

"Thrombol" (thromboplastin), or other local coagulant

Butesin picrate ointment

1 per cent aqueous mercurochrome (or hexylresorcinol)

Preparation of Patient—The sacrococcygeal region is dry shaved and the skin cleaned with alcohol and ether The patient lies on his right side with the knees drawn up and a comfortable pillow under his head

Arrangement of Operating Room—The surgeon sits with his head on

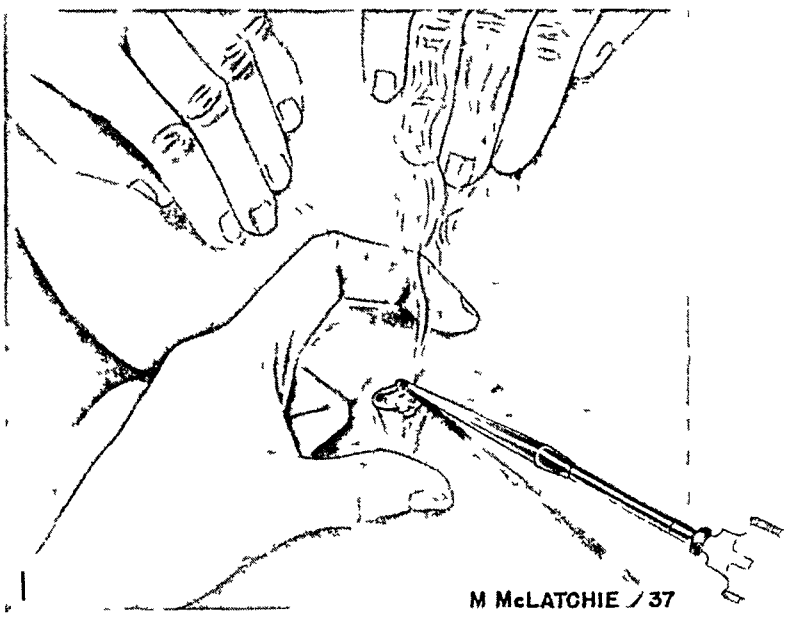


FIG 1—Midline incision with skin held tense to avoid charring This incision may go entirely through the diseased area, exposing the pre aponeurotic areolar layer and dividing the specimen longitudinally into halves, or simply into the hair nest, as in Fig 2

a level with the operative field, with a strong light coming over his shoulder The instrument table is within reach of his left hand The assistant (if any) stands on a platform in front of the patient where he is in a position to retract the left buttock upward

Anesthesia—Using the tuberculin syringe, an intradermal wheal is made along the midline, going both sides of each sinus opening, and extending one inch above and below the limits of the proposed incision Then, using the 5 cc syringe, novocain is injected just beneath the skin to either side of the midline to a distance of about one inch

Skin Incision—With the cautery at maximum heat, and with the skin held on the stretch, an incision is made along the midline (Fig 1), laying open all midline sinus tracts, and extending into or through the hair-nest

Retraction—The skin edge is grasped with tissue forceps and undercut with the cautery for 1 cm along both sides of the incision (Fig 2) The

upper (left) skin edge is then seized with double hooks, which are held up by the assistant If no assistant is available, the self-retaining rake retractor is used instead

Excision—The surgeon, holding the cautery and a sterile sponge in the right hand, and tissue forceps in the left, now grasps the fat to the left of the midline, draws it strongly down and towards him, and with light touches of the cautery divides the tense tissue between the under surface of the skin and the outer surface of the hair-nest (Fig 3) As the division goes deeper,

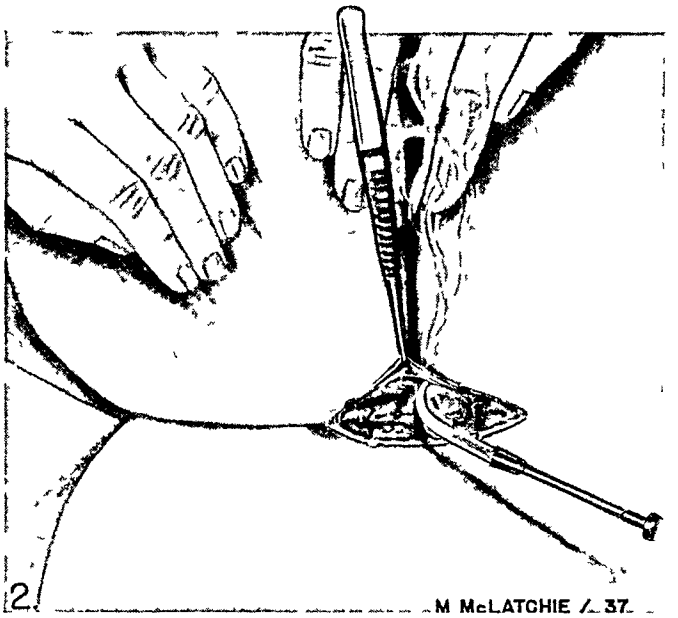


Fig 2—Hair nest laid open through midline incision Skin edges being undercut just enough to allow application of double hooks

the forceps grasp the specimen farther in under the skin edge and roll it forward and downward, always keeping the tissue under the cautery-blade tense As soon as the outermost limit of the diseased tissue has been passed (usually within 2 cm of the midline) the cautery is directed anteriorly until the areolar tissue which covers the sacral aponeurosis is reached This tissue constitutes a definite plane of cleavage, particularly at the cephalad end of the dissection, and it is left intact The left half of the specimen is now peeled away from the areolar-tissue floor of the wound and removed (Fig 4)

The right half of the specimen is excised in the same way, after applying double hooks along the right skin edge (Figs 5 and 6) These double hooks may be held by the assistant, but usually their weight alone furnishes sufficient countertraction and exposure

Hemostasis—The heat of the cautery blade automatically prevents all venous oozing, but does not seal the small arteries, three or four of which are always encountered As soon as a bleeding vessel is reached, all progress should be stopped, the wound sponged, and the bleeding point accurately touched with the flat of the cautery tip If the cautery simply burns the

vessel back farther without sealing it, the heat must be reduced and the maneuver repeated Progress must not be resumed until the bleeding has been stopped

COMMENT ON TECHNIC—The procedure described above is in no sense a destruction of diseased tissue by cauterization but a careful excision, with the cautery used as a knife, carried out under complete visual control, in a comparatively bloodless field Three points should be particularly emphasized (1) The cautery must be of the proper type and in good working order, (2) the surgeon must avoid boiling and frying the tissues, and (3) the hemostasis must be complete and effected as one progresses

We have carried out cautery excisions both with and without aseptic precautions, and we can see no difference in the behavior of the wounds We

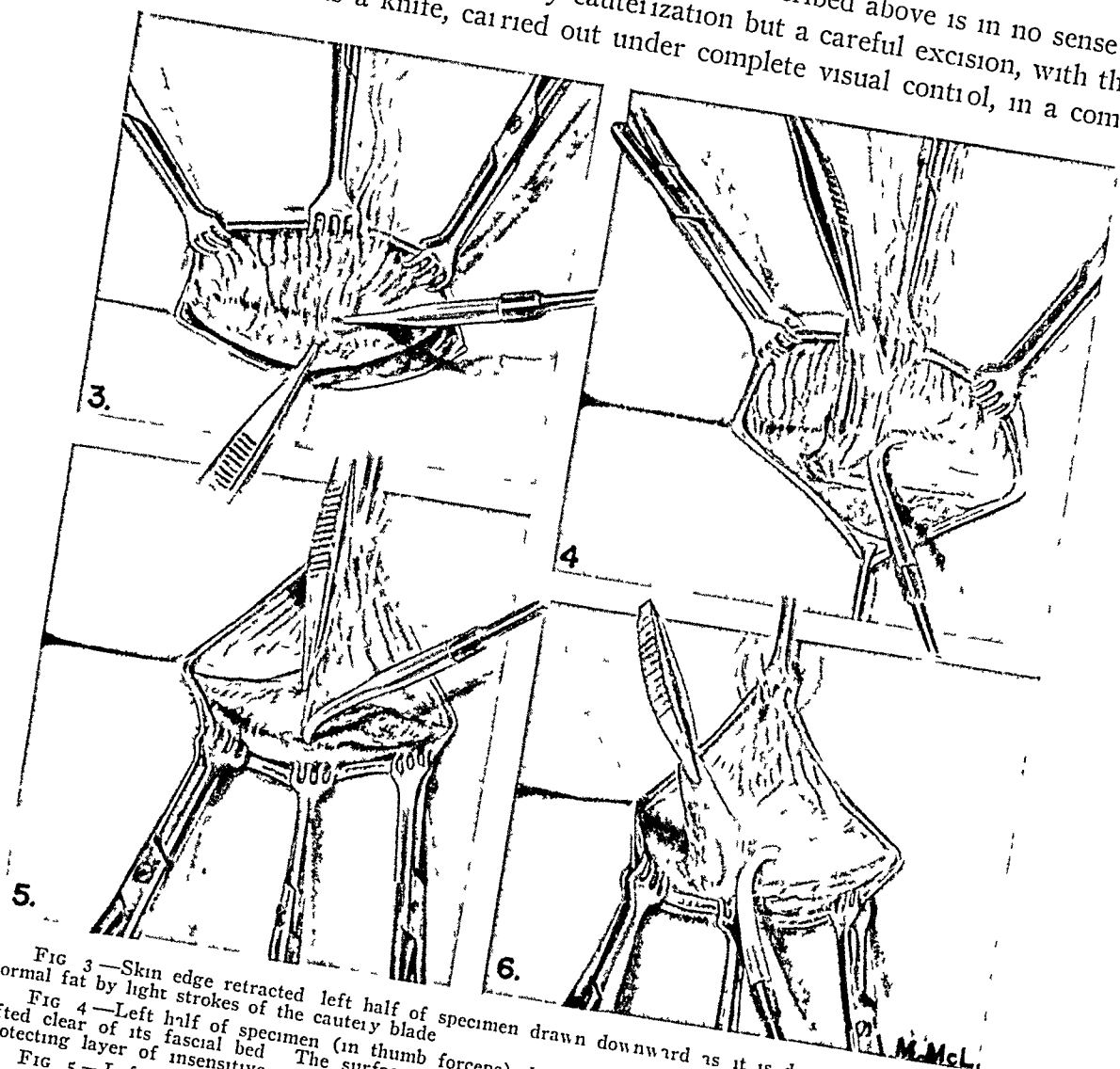


FIG 3—Skin edge retracted left half of specimen drawn downward as it is dissected away from normal fat by light strokes of the cautery blade

FIG 4—Left half of specimen (in thumb forceps) dissected free from lateral fat and now being lifted clear of its fascial bed The surface of the sensitive sacral fascia is seen shining through a protecting layer of insensitive areolar tissue

FIG 5—Left half of specimen removed, and right half being dissected away from lateral fat in the same manner

FIG 6—Right half of specimen almost removed Sketches fail to indicate forward curve of coccyx which, if followed too far will make distal end of wound unnecessarily deep Note absence of charred tissue The wound will be packed open

continue to do the excisions in the Out-Patient Department in every case in which local anesthesia will be effective We have learned, however, that the usefulness of local anesthesia is limited by the presence of extensive scar tissue, and prefer to operate upon such cases under a general anesthetic In 148 excisions the anesthesia was local in 134, ether in eight, nitrous oxide in two, spinal in two, and evipal in two In the average case we plan to take about ten minutes injecting the novocain and ten minutes to accomplish the actual excision We have not yet needed more than 60 cc of 1 per cent novocain

Unless guided by other obvious landmarks, such as induration, we begin our midline incision 1 cm below the lowest opening and carry it 1 cm above the highest one, except in cases having only one opening, when it is carried 4 cm above it The relative size of the wounds was noted as large (over 8 cm long) in 33, small (under 5 cm) in 35, and average in 80 Accessory openings as far to the side as 2 cm can easily be reached from the midline by undercutting, which is carried 0 5 cm beyond them When the disease extends farther than this we do not hesitate to make a second excision at right-angles, and it has been our experience that this cross incision is usually healed before the longitudinal one This was done in five of our present cases, though it should have been done in more, and in only one was it necessary later to excise a corner of skin which persisted in sticking up and becoming epithelialized on its under surface

Though desirable, it is not always essential to remove every bit of scar tissue As our experience has increased, we have become more conservative in the amount of tissue removed, having gained greater confidence in our ability to recognize and remove it later, in the course of a dressing In four cases we have deliberately left scar tissue which would have been awkward, but not impossible, to excise All four patients, however, were cured and are free of symptoms, one more than two years and the others about one year after operation The healing times, in round numbers, were 8, 13, 7 and 7 weeks, respectively One patient in whom the scar tissue extended 8 cm from the midline showed redness and tenderness of the overlying skin for about ten days, which, however, gradually subsided On examination two years later the induration had entirely disappeared In each instance the scar tissue that was left in was a considerable distance from the infected focus of either the main pilonidal abscess cavity or of any of its accessory drainage tracts, and appeared to be homogeneous "healthy" scar tissue containing no chronic granulation tissue or debris The decision to leave such scar tissue *in situ* commits one to nothing, since it can be removed at any time during the process of healing when its presence appears objectionable, and we often prefer to leave it, provisionally, rather than make an unnecessarily extensive initial wound

We now believe that it is almost never necessary to expose the surface of the sacral fascia in order to excise all of the diseased tissue The floor of the wound should be the layer of pinkish areolar tissue through which the

glistening white surface of the fascia can be seen and felt Near the lower end of the coccyx this guiding layer merges with a ligamentous structure which must be cut across arbitrarily, and if diseased tissue has extended below this point[4] it will be missed Whether its presence be detected or not, we prefer to leave such diseased tissue for removal at a second stage procedure rather than to approach so close to the anus at the first operation

Such a condition was present in ten of the cases in this series, in eight of which the downward extension was recognized at the original examination In the other two it was overlooked even during excision, and these two cases are accordingly considered as failures In two cases all of the diseased tissue was excised at one sitting, in four a two stage excision was carried out, and in the other four the second stage remains to be undertaken When a low opening is seen, it must of course be distinguished from fistula-in-ano

Two Stage Excision —When extensive lesions are characterized by having one or more openings near the anus we believe the excision of all diseased tissue in one step to be unwise, even though the end-result may be satisfactory, since it produces a cloaca-like cavity too long for its depth and very difficult to keep packed The sides of such a wound are flaccid and redundant when the thighs are extended, so that they either gape apart or curl in, with much rubbing together of the wound edges The gross fecal contamination of so large a wound results in unnecessary pain, bleeding, irritation, and delay in healing Excerpts from the records of two patients, unfortunately treated in this way, may be instructive

Case 1 —E F D, male, age 24 Operated upon March 12, 1935 Cautery excision Spinal anesthesia Midline incision through multiple sinus openings over coccyx, meeting scattered bunches of hair Extensive scar tissue encountered for 2 cm on either side of midline extending downward almost to anus Sinus tracts and scar tissue excised down to sacral fascia, a few sphincter fibers being exposed at lower end of wound

April 3, 1935 Lower half of wound foul, bleeding and painful

April 7, 1935 Lower end bleeding and sensitive Almost impossible to keep pack in

May 4, 1935 Filled in and starting to epithelialize Scar irregular with lipped edge on left and considerable deformity

May 18, 1935 Scar macerated for two inches by stiff hairs growing from rolled-in skin edge opposite Must be kept shaved

July 6, 1935 New epithelium chafed off near lower end May need plastic to smooth scar and prevent this

July 27, 1935 All healed and solid, 19 weeks, four days

Case 2 —G N, male, age 17 Operated upon December 13, 1934 Cautery excision Ether anesthesia Midline incision from level of an accessory opening over the sacrum to just above anus where hairs were seen protruding from a small sinus opening

December 22, 1934 Still foul Bleeds from lower end when pack removed

January 5, 1935 Almost impossible to keep lower end packed Quite impossible to keep it clean

January 7, 1935 Very bloody and sensitive

January 26, 1935 Needs shave but skin too abraded

February 2, 1935 Clean and comfortable for first time

March 6, 1935 Small granulating area at lower end Still irritated

March 23, 1935 Dime-sized area at lower end still lacks epithelium

April 6, 1935 Healed throughout, 14 weeks, one day
April 12, 1936 Soft scar No symptoms

At the first stage the diseased tissue in the posterior perineum is deliberately ignored The transverse fold of tissue dividing the plane of the back from the plane of the perineum is easily seen with the thighs extended, but is less marked when the thighs are flexed This fold should not be divided In borderline cases, however, we have sometimes saved the patient a second stage by tunneling under it for a short distance when this maneuver would suffice to remove all the diseased tissues The cavity resulting from the first stage excision is kept packed and allowed to heal except for the sinus remaining at or below its lower end

We believe it is important that the first wound should have been healed for several weeks or even months before the second stage is undertaken The three appended case reports illustrate this point

Case 1—H K Seven weeks after first stage, when wound was filled by granulation tissue but not yet epithelialized, the second stage was carried out, creating a small cavity whose upper wall was formed by the granulation tissue of the healing wound Within two weeks all the granulation tissue of the upper wound melted away, leaving a single long shallow cavity which took 14 weeks and two days to heal The final result was good

Case 2—C D Wound of first stage was allowed to stay healed for 12 days Within two weeks of the second stage most of the upper wound had broken down and melted away as if by a cytolytic ferment Final healing took 12 weeks and two days The final result was good

Case 3—A R Three months was allowed to elapse after the first wound had healed before undertaking the second stage The first wound stayed intact and the second wound healed readily in seven weeks and three days, resulting in a neat linear scar

At the second stage the dissection is carried up to the lower border of the healed wound The resulting cavity is short for its depth and easy to keep packed, so that fecal contamination and unnecessary motion are minimized Even under the best circumstances, however, the lower wound is more troublesome than the upper, since it lacks the splinting effect of underlying bony structures, is more vascular, and is subject to greater contamination

After Care—The original dressing is intended to minimize postoperative pain, bleeding and sepsis The cavity is lined with sterile gauze soaked in thromboplastin, and then more gauze is introduced, soaked in a very mild antiseptic such as aqueous metaphen, mercurochrome (2 per cent), or hexylresorcinol until the cavity is snugly, but not tightly, packed, an analgesic paste such as butesin or nupercaine ointment is spread over the skin edges A large sterile pad is then tightly held in place by two wide strips of adhesive plaster across the back

The patient is allowed to walk home at once unless he has taken a general anesthetic, when he is kept in the hospital at least over night He is warned to hold the lower edge of his dressing in against the base of his spine during defecation to avoid soiling If comfortable, he may return to work the first day after operation

The outer pad is changed as necessary, but the pack is not removed until

the fourth day No coagulant is used at this or at subsequent dressings We prefer not to use butesin ointment again after the first dressing since having seen two cases of butesin dermatitis apparently resulting We have found liquid obtundia useful in subsequent dressings of painful wounds, though its odor is rather pronounced After the second dressing, the wound is repacked as often as necessary until all necrotic tissue has disappeared, usually in about one week

From the time the wound becomes clean until it has filled with granulation as much as it will, dressings may be done as far apart as twice a week During this phase of healing our object is to do nothing to inhibit the growth of tissue cells and if possible, to stimulate their growth A balance must therefore be struck between too great ardor in the use of chemicals to destroy bacteria, (and at the same time tissue cells) and too great apathy towards harmful bacterial invasion of the wound Only by personal supervision of the wound can such a balance be struck We have found the use of zinc peroxide ointment in the depths of the wound helpful when we employed an active preparation, and apparently harmless when we used an inert one, in accordance with Veleney's[5] experience in other conditions Care of the surrounding skin must not be neglected during this time We allow several layers of adhesive plaster to accumulate before removing them, cleaning the skin with ether, painting it with tincture of benzoin, and starting a fresh accumulation of adhesive in a new place At each dressing the skin about the wound is shaved and cleansed and covered with a thin protective coating of zinc oxide ointment

In the present series we thought it necessary to trim away bits of doubtful-looking granulation tissue in 27 cases with scissors, in 33 cases with a sharp curette, and in four others with the cautery, sometimes with the help of novocain but more often not We feel sure that a certain number of failures were prevented in this way

Small plastic procedures were carried out before the wound was healed in nine cases One was dissecting up a skin flap which had grown down to the wall of the wound because the packing had fallen out and remained out for a week Four consisted of trimming off a raised skin edge which had become epithelialized on its under side One of these edges was a corner formed by a transverse, accessory incision Another procedure was the excision of a strip of skin between the incision and a lateral opening, which threatened to turn into a tubed graft Three were skin incisions made parallel to the wound to hasten the final stage of scar formation by removing tension from scars which showed a tendency to longitudinal cracking

As the granulating tissue approaches the level of the skin, new epithelium begins to grow across it from the skin edges At this stage we change to a dressing designed to stimulate epithelial growth A strip of sterile gauze soaked in thioglycerol is laid along the wound and thickly covered with zinc oxide ointment to keep the thioglycerol from soaking up into the dry part of the dressing Although we have been unable to prove it quantitatively, our

clinical observations convince us that thioglycerol does promote epithelial growth [6 7]

Scar Formation—In wounds which heal rapidly there appears to be a very perfect synchronization between the granulation and epithelial tissues, the former slowing down as it approaches a normal depth, the latter speeding up to form a level scar In many wounds, however, due to the intervention of unfavorable factors, this synchronization is lacking When the epithelialization is too slow, the granulation tissue may grow up beyond the normal level, forming a sort of coxcomb which has to be kept trimmed down until the epithelium can grow across We have not seen this happen when thioglycerol was being used

When the granulation is too slow, the epithelium begins growing down into a groove or cavity for which it will eventually form a lining We no longer make any effort to prevent this development, as our follow-up examinations have shown that most of the resulting depressed scars tend in time to assume a normal level When the groove into which epithelium is growing is very narrow, however, a surprising phenomenon is often observed Instead of growing down the walls of the groove, the epithelial membrane will bridge straight across, leaving an empty space beneath its under surface If this is not prevented, a false scar will be formed, which will later break down revealing one or more indolent granulating cavities of varying depths About 20 per cent of our cases exhibited this phenomenon

Where both granulation tissue and epithelium are too slow the wound is in danger of becoming essentially a chronic ulcer After failing to stimulate tissue growth by various means, we have several times succeeded in obtaining a satisfactory scar by the use of pin-point skin grafts

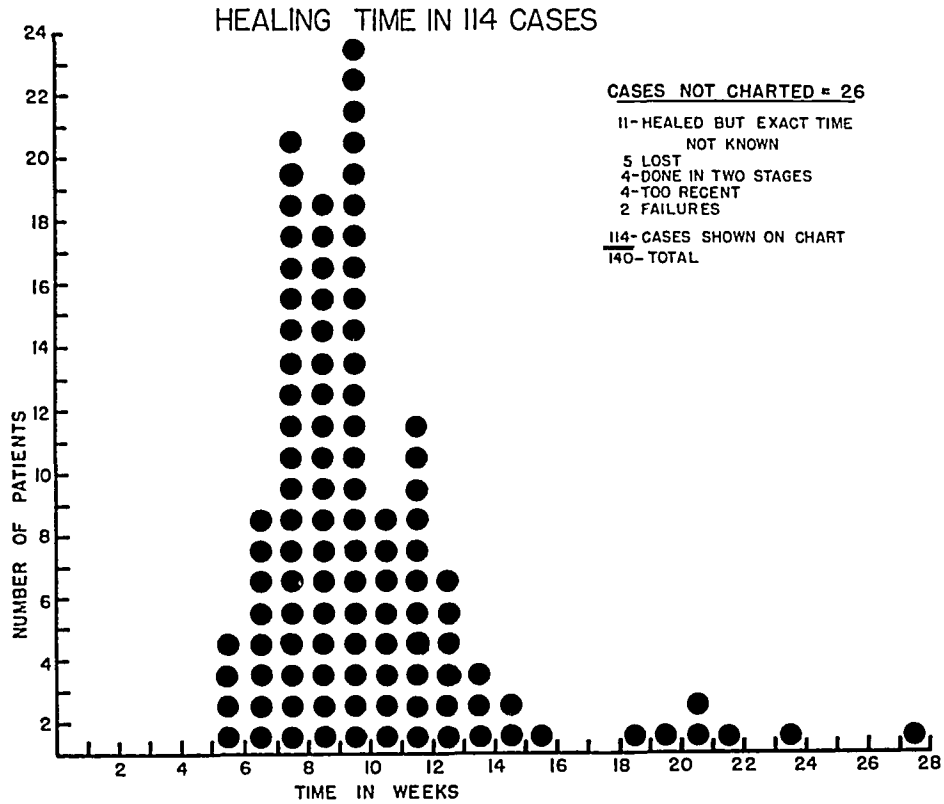
Healing Time of Wounds—The time required for complete healing of the wound is accurately known in 114 cured cases (Table I)

It will be noted that the time is less than 14 weeks in 90 per cent of the cases, less than 12 weeks in 80 per cent, and less than ten weeks in 64 per cent, with a minimum of five weeks The 10 per cent of patients whose wounds took longer than 14 weeks to heal present an interesting and complicated problem After tabulating the size of the wounds, the healing time, and the sex of the patients, we are convinced that the sex and size of wound play no significant rôle in the rate of healing We are unable to generalize about the rate of healing since we feel that all of the factors to be discussed under the head of complications must play significant parts

Other things being equal, the comparative usefulness of a method must be judged First, by whether it cures the patient, and second, by how long it takes to do it A long healing time is obviously undesirable, and everything should be done to shorten it We believe, however, that those patients who took so long to heal would probably not have been cured at all by other methods, for the factors which in other methods produce failures produce only delay in this In other words, we believe that this method is fool-proof to a high degree

COMPLICATIONS—*Bleeding* Postoperative bleeding, which was encountered eight times in our hospital series and twice in private practice, was never of serious consequence It appeared to be due to one of two causes—imperfect hemostasis, with bleeding within 24 hours, or opening of a small vessel due to the separation of a slough between the sixth and eighteenth postoperative day In three cases the bleeding took place within 24 hours, in the other seven it occurred 6, 7, 7, 7, 12, 18, 18 days after operation The bleeding was stopped in five cases by cleaning out the clot and applying a fresh gauze pack In the other five cases the bleeding vessel was seen and either crushed with a hemostat, cauterized, or ligated The wounds healed

TABLE I



normally in all of these ten cases, and all ten patients are cured and symptom free

We believe that better operative technic will reduce both types of bleeding to a minimum During excision each small artery must be directly cauterized as it appears The temptation is to ignore a little bleeder for the moment and defer the control of hemorrhage until the excision has been completed This delay gives an occasional vessel an opportunity to retract and escape cauterization, only to reopen and bleed when the local adrenalin effect has worn off and the patient's blood pressure has become elevated by activity

Excessive slough in the wound is always caused by trying to divide tissue when it is relaxed instead of held under tension The cautery then boils and fries the tissue but cannot divide it cleanly At the end of an operation, the

surgeon's left hand should be lame from holding the tissue forceps while his right hand should have exerted no force whatever in the manipulation of the cautery Excessive slough not only predisposes to secondary hemorrhage, but causes pain and delays healing

Pain—The majority of the patients in this series required no sedation, lost no sleep, and experienced nothing other than soreness on sitting down during the first few days after operation The discomfort was invariably greatest between the third and fifth day, as this is the time when the devitalized tissue is separating, and since the most severe pain has been noted in the cases of patients having the greatest amount of slough, we have concluded that the pain is caused chiefly by the exposure of sensory nerve filaments to the irritating influence of gauze, discharges, and air Slough associated with skin or with sacral fascia causes the most pain because these structures are more sensitive than fat Direct burns of the sacral fascia are capable of causing immediate pain

Seven patients experienced severe pain, in four instances sufficient to bring them back to the Emergency Ward after operation In one the pain began on the day of operation and reached its height on the fifth postoperative day In the others the pain started about 48 hours after operation and increased up to the fifth day They became comfortable between the seventh and fourteenth postoperative day In two of these cases the excision had been performed by surgeons who were trying it for the first time, and in another a defective cautery was employed The other three excisions were all very extensive, but should not, for that reason alone, have resulted in painful wounds Six of the painful wounds healed in 7, 8, 10, 11, 11, and 15 weeks respectively The seventh will be discussed in connection with abscess formation

Fungus Infection—Repeated clinical observations have led us to believe that many instances of delayed healing, and some failures, are caused by the spread of a fungus infection from the patient's perineum or feet to the pilonidal wound This complication is characterized by arrested progress, tenderness or pain and sometimes itching, a disagreeable sour odor, and a white, moist, crumbling skin edge around the wound It is relieved by the application of any simple fungicide, for example Two parts each of acid salicyl and sulphuris praec, and 30 parts of petrolat (M G H ointment No 20) This ointment may safely be used in either full or half strength The condition has been observed in varying degrees in perhaps 30 cases in our present series In retrospect we think it likely that many of our cases of prolonged healing were due to this unrecognized complication Three striking cases are appended

Case 1—R J, female, age 26, had a very small excision, and progress was excellent for six weeks, when the patient complained of soreness, itching, and sour smell which she had not noticed before This increased for two weeks inspite of frequent dressings At eight weeks the marginal skin looked boggy and white, the macerated epithelium could be scraped off, revealing a bluish, inert base The resemblance to macerated skin between

the toes in epidermophytosis was so marked that we applied M G H ointment No 20 to the whole wound as an experiment Within four days all her symptoms had ceased, and healing was complete two weeks later, ten weeks and four days after operation

Case 2—S S, male, age 21, had a small excision, did well, and was almost healed at nine weeks He then complained of itching, soreness and a sour smell The wound had partially broken down with maceration of the skin edges and loss of new epithelium in spots He got worse for two weeks M G H ointment No 20½, was then started, the symptoms disappeared, and the wound was all healed 12 weeks and six days after operation

Case 3—P S, male, age 22, had a small excision, with a resultant unusually clean wound and rapid healing up to 20 days The skin edges then became macerated, granulation tissue edematous progress stopped, and the patient complained of soreness At four weeks a sour odor was present in the wound, and the patient complained of itching M G H ointment No 20 was applied At five weeks the symptoms had ceased, granulation tissue looked normal, a thin film of epithelium was growing out from the skin edges The wound was completely healed at nine weeks

Abscess Formation—The convalescence of six patients was complicated by the formation of an abscess All six operations had been performed under local anesthesia, but in only two cases could this have been a factor In one an abscess appeared 4 cm from the wound seven days after operation and required incision and drainage through the intact skin It then subsided rapidly, and convalescence was uneventful In the other, excision was carried out in spite of what appeared to be a pimple, but probably was a small furuncle, 1 cm from the midline opposite the center of the incision By the fourth day tenderness was marked and poultices were instituted On the eighth day pain brought the patient to the Emergency Ward where, after 48 hours of poulticing, an abscess at the site of the pimple opened spontaneously and discharged one-half ounce of pus An additional abscess appeared on either side of the incision, both of which required incision and drainage Convalescence was uneventful

We believe that novocain should not be injected through an infected area into a clean one which is not going to be given ample drainage by the impending excision For this reason we limit ourselves to a midline, intradermal wheal of novocain along the line of incision, extending the anesthetic field by injection under the skin edge only so far as we expect to undercut it We anesthetize the sensitive sacral fascia only under exceptional circumstances, and then with misgivings Whenever it appears that extensive scarring will force us to violate these principles, we prefer to use a general anesthetic General anesthesia was used in 14 out of 148 excisions

In three cases an abscess appeared near to, but apparently unconnected with the wound of excision from six to seven weeks after operation, and all required evacuation of the pus by incision and drainage Better care of the skin might have prevented them In none of the five cases mentioned did the abscess interfere with a successful outcome The fifth case presented a complication which is fortunately rare The patient was a stolid man, age 40, who had, at operation, "hair in the midline with scar and inflammatory tissue extending three inches into the buttock on the right" For four weeks after operation he was never free of pain Rectal examination showed indura-

tion and tenderness in the right ischiorectal fossa, which on incision through the buttock, under general anesthesia, proved to be a large abscess communicating with the pilonidal wound No opening within the anus or rectum could be found The patient was immediately relieved of pain, and both his wounds healed uneventfully, but it is too soon to know whether he is cured In retrospect it is obvious that a rectal examination should have been made sooner, as the promptness of his pain suggests that even at the time of operation extension into the ischiorectal tissues may have been present

Defects in the Scar After Healing—*Superficial Maceration* In five cases small areas of superficial maceration appeared in the scar from 12 days to one year after healing In each instance there was evidence of poor hygiene and lack of care of the scar When this was remedied the macerations disappeared in from two to seven days All patients, on discharge, are instructed to wash and powder the scar daily, and protect it by a small strip of absorbent cotton held in place by the underwear After several month the scar is usually tough enough to take care of itself

Longitudinal Cracking—Of this there were four instances, occurring from 17 days to one and one-half years after healing, no crack exceeding 1 5 cm in length, and none taking longer than eight days to heal They all were due to some sort of physical violence, such as a fall in the sitting position A fifth patient scratched his wound open in his sleep, because of intolerable itching during hot weather, seven days after it had healed Healing was again complete in three weeks

Bridging—In about 20 per cent of the wounds the last epithelium to form showed a tendency to bridge across narrow defects instead of growing down into them In one case we neglected to cut back this bridging epithelial membrane, so that seven days after healing was apparently complete a pinhole-sized opening was discovered in the scar A probe introduced through it entered a granulating cavity 1 cm deep and 0 5 cm wide, containing no evidence of a sinus in its floor or walls After a few days of packing the cavity healed up from the bottom to an intact scar

Epithelial Pouches—In three cases a pouch was formed by the downgrowth of epithelium into a fairly deep granulating cavity One was 2 cm deep with an intact lining of dry skin, and caused no symptoms The two others became inflamed three and one-half and seven months after healing, apparently due to poor hygiene, and presented a picture similar to omphalitis Both required small plastic procedures to enable the patients to keep their scars clean Pouch formation is merely an exaggerated form of the depressed scar, which usually tends to flatten out spontaneously as the scar tissue becomes soft

Superfluous Skin—Two patients developed completely epithelialized bridges of skin beneath which a finger in one case and a probe in the other could be passed The larger resulted from the surgeon's unwise employment of a second incision parallel to the midline incision when he found himself unable to reach a lateral extension of scar tissue from the midline In the process of

healing, the intervening strip of skin tubed itself, the new epithelium growing completely across underneath it In the second case the skin tubed itself between the midline incision and an unusually large lateral sinus opening This development was prevented in several other cases by sacrificing such narrow bands of skin Although such bizarre skin formations may cause no symptoms, they delay healing and should be avoided When scar tissue cannot be reached by undercutting from the midline, it should be exposed by a second incision at right angles but never parallel to the midline incision

Late Abscess Formation—Our most troublesome case was one in which an indolent abscess formed in the lower end of the scar one month after the wound had become healed, and continued to drain for two months before the patient returned to the clinic Believing that this abscess cavity, even though it contained no hair or epithelium, was capable of producing a persistent sinus, we excised it with the cautery The wound then healed after 27 weeks of packing, and has remained healed for several months Fungus infection appeared to be a factor in the unusually slow healing, and may have been concerned also in the formation of the abscess

Residual Symptoms—Of the patients known to be cured for at least one year, 70 (49 male, 21 female) have been questioned about posthealing symptoms Fifty (71 per cent) have no symptoms and are never conscious of their wound Eighteen (26 per cent) have, or have had, symptoms of minimal magnitude Two (3 per cent) have residual pain Thus, 97 per cent of this unselected group have complete or almost complete freedom from residual symptoms

The minimal symptoms fall into two general classes Those associated with long sitting on a soft substance, *i e*, pressure, and those due to other activities or conditions, or having no known association with anything

Of the 11 patients in the first class, five described a "faint dull pain" on rising In one case this ceased after one year, in another after one and one-half years Three patients still have it, but one only after a long automobile drive Two patients described "discomfort," and one each "soreness," "heavy feeling," "numb feeling," and "pulling sensation"

Of the seven patients in the second class, two described dull pain off and on during damp weather, one had a single twinge of pain two years after healing, one has "occasional slight momentary pain," one had "slight pain" for three weeks, one has itching in warm weather, and one has a "tight sensation on stooping over sometimes"

The two patients with more than minimal symptoms are of interest from a diagnostic as well as a therapeutic point of view Both were females, and both had smaller than average wounds

Case 1—A B, a Negress, for one and one-half years after healing, had been suffering from what she described as "an ache like a toothache" which prevented her lying on her back or slouching in a chair It always came on after long sitting and occasionally at other times She said the pain never radiated Examination showed an intact, soft, linear

scar 5 cm long There was slight tenderness over the sacrococcygeal joint, but no pain on manipulation of the coccyx through the rectal wall

Case 2—C D, was symptom-free for six months after healing She then started doing gymnastics and began to notice that it caused pain in the wound, as did playing tennis during the summer, until by fall, sitting down for long periods also caused an aching pain, described as a dull ache at the lower end of the sacrum and sometimes radiating "up the spine" Examination showed an intact, soft, freely movable, almost invisible linear scar, with tenderness confined to the sacrococcygeal joint, but no pain on moving the coccyx from behind or through the rectum

In reviewing the phenomena of residual symptoms, we find nothing that throws any direct light on its mechanism Of the 20 patients concerned, 18 had wounds of average or smaller than average size There is nothing about the rate of healing or the resultant scars which singles these individuals out from the rest The only finding which may be of any significance is the sex incidence of those suffering from residual symptoms We found an equal number of males and females, instead of the 3 1 ratio characteristic of the series as a whole

If this sex incidence of those having residual symptoms is more than a coincidence, it suggests that the anatomic differences in the male and female pelvis may be concerned Duncan[7] has pointed out that these differences expose the female coccyx to more trauma than that of the male, which is relatively well protected by its more pronounced forward curve Other things being equal, this difference may account for the high relative incidence of painful coccyx in females (97 per cent) and the high incidence of pilonidal sinus in males (66 to 80 per cent), since the trauma which plays a rôle in the etiology of pilonidal sinus in males is in females absorbed by the more prominent coccyx After operation for pilonidal sinus, however, the situation becomes altered, for in both sexes there is now scar tissue overlying the coccyx, but in the female it is more exposed to direct trauma than in the male Assuming that trauma to scar tissue could cause such symptoms as we have observed, the sex distribution might be accounted for on this basis If no other factors than scar tissue and trauma be responsible, however, it is odd we do not find residual symptoms in all cases, since these same factors must be present in all

Our experience leads us to the conclusion that a certain incidence of such residual symptoms as we have described is unavoidable following surgery in the sacrococcygeal region, and that if they are not mentioned by other observers it does not mean they are not there, but that they have not been looked for

FAILURES—In the case of two patients who were thought to be cured, a pin-hole opening was later discovered below the bottom of the scar One was found on routine follow-up examination one year and four months after the patient's last visit, at which his wound was not entirely healed It was a tiny opening resembling an enlarged pore 2 cm below the lower end of a well healed scar, and from it protruded two or three hairs It had not caused symptoms, and the patient was not conscious of its presence The other pa-

tient was examined 13 months after his last visit and found to have a pin-hole opening with a protruding hair just at the lower end of a well healed scar It had drained once in a while, but he did nothing about it as it "didn't bother him much"

These small openings were missed, presumably because at the time of operation they contained no hair Even had they been seen, as with more care they would have been, it is probable that the same operative procedure would still have been carried out, but with the expectation of a second stage if developments should prove it to be necessary That is what will be done now with every prospect of cure, but honesty demands that these two cases be rated as failures at the present time

SUMMARY —A series of 140 patients with a 3 1 male to female distribution, all treated by cautery excision and open packing, is described

The rationale of this method of treatment is discussed

The technic of cautery excision and care of the wound is reviewed in the light of the authors' experience, with particular reference to complications

The results of treatment are presented in some detail

CONCLUSIONS

Since, in a personal experience with some 400 cases of pilonidal sinus we have not yet seen one communicating with the neural canal, we conclude that it is a rare occurrence Roentgenographic examination with iodized oil injection is superfluous except in markedly atypical cases

We have never seen cancer develop in a pilonidal sinus

Under ideal conditions for visualizing the gross pathology of pilonidal sinuses (*i e*, cautery excision) we have seen none extending into the sacral hiatus, sacrococcygeal joint, or beneath the sacral aponeurosis

The two essentials for cure are (1) Removal of diseased tissue, and (2) solid healing of the wound

Though the technic of removing diseased tissue is unimportant compared with the subsequent treatment of the wound, we see no advantage in performing its excision by a difficult procedure when a simple method is available (*i e*, cautery excision)

Because of the unavoidable obstacles to sound healing by first intention, in pilonidal wounds, we believe that open packing and healing by second intention will produce the highest percentage of cures in unselected cases

In selected cases it may still be desirable to incur the greater risk of failure associated with primary closure for the sake of shortening the treatment time in those which succeed

REFERENCES

[1] Rogers, H, and Hall, M G Pilonidal Sinus Surgical Treatment and Pathologic Structure Arch Surg, 31, 742–766, 1935

[2] Rogers, H Pilonidal Sinus Surg, Gynec, and Obstet, 57, 803–810, 1933

[3] Ferguson, L K, and Mecray, Jr, P M Pilonidal Cysts Excision and Primary Suture in Ambulatory Patients Am Jour Surg, 36, 270–278, 1937

[4] Gage, M Pilonidal Sinus Explanation of Embryologic Development Internat Clin, 3, 19–32, 1936
[5] Meleney, F L, and Johnson, B The Prophylactic and Active Treatment of Surgical Infections with Zinc Peroxide Surg, Gynec, and Obstet, 64, 2A 387–392, February 15, 1937
[6] Hammett, F S, and Riemann, S P Cell Proliferation Response to Sulphydryl in Man Soc Exper Biol and Med, 27, 20, 1929
[7] Duncan, G A Painful Coccyx Arch Surg, 34, 1088, 1937

TREATMENT OF FRACTURES OF THE SHAFT OF THE FEMUR*

AN ANALYSIS OF ONE HUNDRED TWENTY CASES

ROBERT H KENNEDY, M D

NEW YORK, N Y

FROM THE SURGICAL SERVICE BEEKMAN STREET HOSPITAL, NEW YORK N Y

FRACTURE of the shaft of the femur is a common, severe injury, frequently resulting in death, permanent disability or prolonged invalidism Any information which may aid in improving these results should be made available We can determine whether certain types of treatment should be continued only by knowing what can be expected of them The evaluation of a method depends upon a comparison of an analysis of a group of cases so treated with analyses of other methods We have analyzed 120 consecutive cases of recent fracture of the shaft of the femur treated by the staff of the Beekman Street Hospital, from January, 1924, to March, 1932 It seems worth while to make these observations available in order that other methods, as they have been or are devised, may be compared with them, in order to determine their relative value

Before the War of 1914–1918, the usual handling of these patients consisted of reduction under anesthesia followed by immobilization by plaster encasement Sporadic attempts had been made to introduce traction in the form of Buck's extension or insertion of a Steinman pin and also open reduction with internal fixation None of these methods made much progress, and reduction and plaster encasement continued to be the routine treatment This was difficult to carry out in compound fractures and, in all types, resulted in shortened limbs, poor weight bearing axes and loss of joint function with appalling regularity

At the commencement of the war, application of a plaster encasement or internal fixation of fragments was the common procedure in compound fractures of the femur It soon became evident that the results of either method were too unsatisfactory to continue their use Traction methods became popular, at first by pull on the skin and later by pull directly upon the distal fragment of bone

On returning to civil practice many surgeons reverted to the plaster encasement of both simple and compound fractures, but the majority of those with a particular interest in fractures continued to use some form of traction The latter believed that the original length, proper axis and complete function were to be desired in every case, and that these results were difficult to obtain following immobilization by a plaster bandage

Beekman Street Hospital was reorganized in 1924, and the senior mem-

*Read before the New York Surgical Society, March 10, 1937 Submitted for publication, May 22, 1937

bers of the new surgical staff had all had war experience They were uniformly in favor of some form of traction and against the use of a plaster encasement unless the type of fracture was such that slipping after reduction seemed unlikely The institution is a general hospital of 100 beds with a single operating room The house staff has a rotating service It receives many infected cases and is in a district where gas bacillus infection is common These are the chief reasons why it was thought that open operative reduction should not be employed by the staff unless other methods had proved unsatisfactory That is, open reduction was not performed as a primary treatment of choice in fractures of the shaft of the femur However, for several years, any open operative bone work has been in charge of one surgeon only This arrangement was begun after the period which this report summarizes

The patients to be considered have been treated by some ten surgeons, although each case has had the advantage of general staff discussions of the details of the treatment We believe that the proper transportation of the patient to, and within, the hospital is a major factor in treatment [2,3] The routine use of fixed traction on our ambulances was insisted upon during the latter half of the period considered

There were 17 early deaths in this series Fourteen had multiple, severe injuries of which the fracture of the femur formed only a part One died within 48 hours of alcoholism and delirium tremens One patient had fractures of both femora, one of which was compound A debridement of this was effected and adhesive plaster traction instituted He died within 24 hours from a cerebral embolism The other instance of early death occurred in a case of severe compound comminuted fracture of the lower third of the shaft with severe hemorrhage His condition was such that only packing of the wound was feasible the first day A débridement was effected on the second day, and an amputation through the site of fracture on the fourth day, on account of gangrene of the leg from disturbance of the blood supply The patient died on the sixth day The time of death in these 17 cases is shown in Table I

TABLE I

TIME OF DEATH IN 17 EARLY MORTALITIES

Time Elapsed	No of Cases	
Within 2 hours	6	
Between 2 and 12 hours	6	(Three of these were compound, skeletal traction had been instituted in one)
Between 12 and 24 hours	2	
During the second day	1	(Compound, skeletal traction had been instituted)
During the fifth day	1	(In skeletal traction)
During the sixth day	1	(Amputation)

In addition to the death following amputation, two other patients had amputations and survived One was a child, age nine, who had an extensively

comminuted compound fracture of the middle third of the shaft with maceration of the soft parts of the leg A transfusion was given shortly after admission followed within 24 hours by a second transfusion and a disarticulation through the knee On the twenty-third day an elective amputation was performed through the middle of the thigh The other patient had a closed fracture of the middle third with extensive hemorrhage into the thigh By the fifth day he had developed a deep cellulitis of the thigh In spite of surgical treatment, the cellulitis continued to extend and an amputation, through the upper third of the thigh, was performed on the nineteenth day

There remain 101 patients available for more detailed analysis of their treatment Since the problem varies somewhat in different regions, the series has been divided into three groups the upper, middle, and lower thirds

Upper Third—This group does not include fractures of the greater or lesser trochanter nor intertrochanteric fractures, except when these accompany, as relatively unimportant features, fractures of the upper third of the femur in the same patient

There were 17 patients in the group, 14 males and 3 females Their ages ranged from 5 to 15 years, 2, 16 to 29, 4, 30 to 39, 4, 40 to 49, 1, 50 to 59, 2, 60 to 69, 4 There were no compound fractures Four were comminuted

The causes varied from slipping on a banana peel or a rug to falling six stories, four stories and from an elevated railroad platform to the street Only four were the result of motor accidents In 11 instances the trauma seemed severe and in six relatively slight The appearance of the roentgenogram did not vary greatly, irrespective of the severity of the violence Two persons were struck locally with heavy objects and three others believed that they had sustained a direct blow on the upper thigh in falling short distances Whether the fracture was due to direct or indirect violence in the others was undetermined

In one instance the lesser trochanter formed a part of the long distal fragment, in one case it was broken off separately, in another both the greater and lesser trochanters were broken off separately, and in a fourth the greater trochanter was separated In one patient there was a long oblique fracture commencing just below the lesser trochanter and in addition a transverse fracture in the middle third of the femur This patient had other serious injuries in addition which increased his disability namely, fracture of the bodies of the second and third lumbar vertebrae, fracture of the patella and calcaneus on the same side as the fractured femur, and fracture of the tarsal scaphoid and second metatarsal on the opposite side Three other patients had complicating injuries as follows Fractures of the pelvis, laceration of the brain and fracture of the olecranon process and multiple fractures of the pelvis, fracture of two ribs

The typical displacements in this fracture are abduction, flexion and external rotation of the proximal fragment, as a result of the action of the muscles attached to the trochanters and the intertrochanteric line In most

of these patients the first roentgenologic examination was made with the extremity in emergency traction In spite of this traction, nine of the initial roentgenograms showed, to some extent, the typical deformity, which makes this type so difficult to treat

The first definitive treatment in the hospital was adhesive plaster traction with Thomas splint suspension in ten patients, ice tongs in six, and overhead traction to both legs in a child, age five The adhesive plaster traction treatment was unsatisfactory in four instances In one of these a closed reduction, under general anesthesia, was attempted on the fifth day and a plaster spica applied, an open reduction with Lane plating was effected and a plaster spica again applied on the eleventh day because the reduction was not maintained In two other patients ice tongs were substituted, and in one a Steinman pin was introduced through the distal portion of the femur That is, the final treatment was skeletal traction in nine instances, adhesive plaster traction in six, open reduction in one and overhead traction in one

In using adhesive plaster, the first weight applied varied between 12 and 40 pounds, being 15 pounds in five cases, the permanent weight was usually 15 pounds With skeletal traction the initial weight applied varied between 20 and 35 pounds, averaging 27½ pounds It is evident that, in general, adhesive plaster was employed where it was thought less traction was necessary, since the effective pull averaged only slightly more than one-third as much In addition six of these ten cases occurred during the first three years of the period reported, at which time we employed skeletal traction less frequently In five instances the adhesive traction treatment was commenced immediately after admission and was satisfactory four times It was begun the day after admission three times, twice unsatisfactorily, and not until the second day twice, being unsatisfactory once

When roentgenlogic examination demonstrated that the desired position had been attained, 15 pounds was the usual amount of skeletal traction maintained Skeletal traction was not removed until the one hundred ninth day in the patient with fractures of both the upper and middle thirds of the femur One patient died of embolism on the seventeenth day Omitting these two, the tongs were removed in the remaining seven patients between the twentieth and forty-eighth days, averaging 38 days In all but one instance adhesive plaster traction was substituted, usually with 15 pounds' weight Omitting the same two patients as above and also the case of open reduction, in the remaining 14 all traction was removed at from 38 to 83 days, averaging 62 days One patient, from whom all traction was removed on the sixtieth day, refractured on the seventy-first day, when commencing to use a walking caliper splint He had an open reduction performed on the seventy-sixth day, with application of a Lane plate, followed by traction suspension with a weight of ten pounds attached to adhesive plaster

We know that nine patients obtained solid union and one died For various reasons the remaining seven could not be followed, but the condition when last seen gave no reason to suspect that they would not obtain union

The time of first appearance of any callus, as demonstrated roentgenologically, is mentioned on 14 charts This varied between 28 and 65 days and averaged 42 days Since the usual period between roentgenologic examinations at this stage in treatment was two to three weeks, this figure cannot represent, accurately, the first appearance of callus The precise time of appearance of firm union or solid union is not mentioned on enough charts to make this figure of any value

Ice tongs or a Steinman pin was employed in nine instances One patient died of pulmonary embolism on the seventeenth day, with no infection of the tong wounds In three other patients the wounds remained clean Five became infected One was transferred to another hospital 11 days after removal of the Steinman pin, and the result is not known One still had a purulent discharge 30 days after removal of the tongs, but this condition is not mentioned in the notes for the following three weeks, after which he was lost track of Another still had a discharging wound four and one-half months after removal, when he disappeared One drained for at least six months, but we know that nine months later he had no trouble for many months Another drained for eight months after removal, but following the extrusion of a small sequestrum the wound healed and remained so Some of these cases did not drain continuously, but would apparently heal, only to open again after a few weeks

One patient died during treatment, and we have the late result noted in only six others Four were A_1, E_4, F_4 (Massachusetts General Hospital rating) One was A_1, E_2, F_3 We gave him F_3, because his knee motion was from 180 to 80 degrees, and he had persistent edema of the leg, one year and four months after injury He sustained a refracture through his callus on the seventy-first day, and had an open reduction on the seventy-sixth day Another patient was given A_4, E_0, F_3 He had not returned to work at the end of three years on account of the fracture of two lumbar vertebrae He was given F_3, because he had 90 degrees flexion at the knee

We do not believe that these patients are usually satisfactorily treated in plaster encasements While we used adhesive plaster traction in six of our early cases with fairly satisfactory results, it failed in four other cases, and we do not believe it should be used generally Overhead, bilateral adhesive traction is satisfactory in patients under five years of age Skeletal traction gives excellent anatomic and functional results, but an incidence of infection of the wounds of 55 per cent is a severe indictment of the procedure or of our method of using it At present we would employ the Kirschner wire for skeletal traction, instead of ice tongs or a Steinman pin It has been our experience that superficial soft part infections are even more common with the use of Kirschner wire than with the tongs or pin, but that prolonged discharge after removal of the wire, which we consider an evidence of bone involvement, is rare

Middle Third—There were 74 patients in this group, 64 males and 10 females Their ages were as follows up to 16 years, 42, 16 to 29, 9, 30 to 39,

6, 40 to 49, 8, 50 to 59, 6, 60 to 69, 3 Twenty-five were the result of motor vehicle accidents, and the next most common cause was falling from a height Two were compound and two were comminuted fractures The fact that there were 42 children in this group is important in the incidence of this fracture, for the hospital covers a large business, but small residential, district, in which there are comparatively few children We shall discuss the children's group separately Fifteen of these were not over five years of age

The roentgenologic reports state that there were 11 transverse, ten oblique and four spiral fractures Overriding is mentioned as being present in 19 instances Some of these occurred in the early years before we employed traction splints on the ambulance, and some were brought in by conveyance other than an ambulance Overriding is rarely seen when a fixed traction splint has been applied before admission Without it, marked overriding is characteristic in middle third fractures

Eleven patients had additional injuries as follows Concussion of the brain, three, fracture of the skull, three, humerus, two, nose, one, jaw, one, and patella, one

The first definitive treatment in the hospital for the 15 patients under six years of age was overhead adhesive traction to both lower extremities in ten instances (Bryant traction) This was continued until union was obtained in every case We do not believe overhead traction to one extremity only should ever be employed Closed reduction and a plaster spica was employed three times It was satisfactory in only one instance In another case it was employed three times before being satisfactory In a third patient, after the reduction was unsatisfactory once, adhesive plaster traction with a Thomas splint was successful In two cases this latter treatment was employed primarily, once with a good result and once followed by successful closed reduction and application of a plaster spica That is, the final treatment was overhead traction in ten, adhesive plaster traction in two, closed reduction and application of a plaster spica in three Bryant traction is an excellent method for patients under six years of age

For the 27 patients between the ages of six and 15, the Thomas splint with adhesive plaster traction was employed as the first treatment in 21 instances, 17 times satisfactorily Two of the unsatisfactory cases had a secondary closed reduction under anesthesia with application of plaster spicas A third patient had a Steinman pin inserted through the crest of the tibia, and the fourth unsatisfactory reduction had an open reduction with kangaroo tendon suture, interposed muscle being found Four patients had closed reductions under anesthesia with plaster spica application as their primary treatment This was successful three times In the other case it was repeated, and a Thomas splint with adhesive plaster traction was tried, and finally an open reduction was performed without fixation The two compound fractures had a debridement, one having a plaster spica applied followed by open reduction and wiring on the twenty-sixth day for malposition, and the other the insertion of a Steinman pin through the crest of the tibia That is, the

final treatment was adhesive plaster traction in 17, closed reduction and the application of a plaster spica in five, open reduction in three, and skeletal traction in two We believe that closed reduction with the application of a plaster spica is not usually a satisfactory treatment In all adhesive plaster methods we employ manipulation in bed, under anesthesia, in addition, if satisfactory position is not obtained promptly Traction is immediately re-instituted

With Bryant traction the weight is the same on each leg and should be sufficient to just keep the buttocks from touching the bed We do not fix the trunk to the mattress or to a Bradford frame The weight varies between four and eight pounds Fifteen pounds was an average weight for adhesive traction in a Thomas splint It differs, naturally, with the size and weight of the patient Irrespective of the site of fracture, each adhesive plaster strip should extend as high on the thigh as possible and should be in one strip, and not divided to allow knee movement To attempt the latter loses too much surface to which adhesive plaster can be attached The final weight for skeletal traction was seven to ten pounds

The ten patients treated by Bryant traction had no form of immobilization used later The time of removal of traction varied from 37 to 56 days, averaging 45 days Several of the patients treated in Thomas splints, with adhesive plaster traction, had the traction removed when union was firm and plaster spicas applied In 11 instances adhesive plaster traction constituted the entire treatment This was left on for periods varying from 23 to 62 days, averaging 47 days One Steinman pin was removed after 65 days with no further immobilization, and one after 33 days, being followed by the application of a plaster spica Seventeen patients had plaster spicas applied as their final treatment This includes those originally treated by reduction and plaster encasement, as well as by adhesive plaster traction, skeletal traction and open reduction The time of removal varied from 35 to 169 days after injury, with an average of 78 days Of the older patients in the children's group, several used walking calipers after immobilization was discontinued

In the group under six years of age the first roentgenogram showing callus is recorded 12 times Roentgenograms are not taken as frequently in Bryant traction patients as in others, and those showing callus are usually the first roentgenograms taken after the immediate postreduction film The time of the appearance of callus varied between 14 and 42 days, averaging 24 days But in eight of the 12 patients it was noted between the fourteenth and nineteenth days, so that we may assume that at this age, callus is usually visible by the end of the second week In the older children's group we have reports on callus formation in 20 instances Because of the type of treatment, roentgenograms were taken at more frequent intervals The time of appearance of callus was noted between the eleventh and thirty-sixth days, averaging 22 days

In the group under six years of age, the time of appearance of firm union was noted in eight cases, and varied between 22 and 48 days, averaging 37

days In the group between the ages of six and 15 it was noted in 15 instances, varying between 15 and 84 days, averaging 41 days

Of the entire 42 children, four were lost before solid union was noted There was no reason to expect delayed or nonunion in any of the latter We know that solid union was obtained in all the others One patient fell out of a chair on the fifty-sixth day and refractured the femur, union, however, became solid after 78 days more One compound fracture, which had had an open reduction followed by osteomyelitis, did not become solid for one year Omitting these patients, the time of solid union was noted in nine of the group under six years of age, varying between 25 and 74 days and averaging 54 days In the group between six and 15 it was noted in 14 instances, varying between 38 and 106 days, averaging 72 days

Of the two Steinman pin cases, the wounds in one remained clean, and in the other they became infected and discharged for four months after removal, before remaining healed The two closed fractures which had open reductions healed without infection The compound fracture with open reduction became infected and had delayed union

Of the patients treated in Bryant traction, four showed no shortening, four, one-half inch and in two there was no record Late roentgenograms, while still in the hospital, showed good axes in five, posterior angulation in two, anterior and lateral angulation in one, not reported in two Late follow-up showed F_4 in six and no follow-up in four

Some shortening was present at the end of treatment in 64 per cent of these patients These are not satisfactory results The two patients treated in skeletal traction had no shortening Skin traction resulted in 62 per cent, and reduction and plaster encasement in 85 per cent shortening It suggests that immobilization in plaster of paris is not, in general, a rational treatment Skin traction in this series gave indifferent results

TABLE II

AMOUNT OF SHORTENING IN CHILDREN BETWEEN THE AGES OF SIX AND 15

Amount of Shortening	Immobilization By: Adhesive Traction	Plaster Spica	Steinman Pin Traction	Open Operation
None	6	1	2	—
½ inch	4	3	—	—
¾ inch	2	—	—	1
1 inch	1	2	—	—
1½ inches	—	1	—	—
2 inches	1*	—	—	1
Not reported	1	—	—	1

* This patient signed a release on the thirty-seventh day and was not seen again until the ninety-second day, when a two-inch shortening was present There had been ¼ inch shortening at time of discharge

It is true that many of these extremities regain their normal length with growth, but we cannot consider efficient a treatment, which attempts to obtain

end-to-end apposition, if shortening results in the majority of cases We have felt that this group of children, from six to 15 years of age, was the most difficult in which to obtain a satisfactory anatomic result in the shaft of the femur We believed that it was inadvisable to use a Steinman pin or ice tongs in the femur on account of possible disturbance of the growth, unless this was absolutely necessary We do not believe that this objection obtains for Kirschner wire through the distal end of the shaft proximal to the epiphyseal line

Late roentgenologic examination, while in the hospital, showed good axes in ten, posterior angulations in six, and various other types of angulation in six These angulations were usually slight The result was F_4 in 17 patients, F_3, in one treated by a plaster encasement, with a restriction of knee motion still present at the end of one year, and F_2, in the patient with open reduction followed by osteomyelitis

There were 32 patients over 15 years of age with fractures of the middle third of the shaft There were no compound and 12 comminuted fractures in this group Nine were apparently injured by direct violence, *i e*, some heavy object struck the thigh, 13 as the result of motor accidents, five by falls from a height and the remainder from miscellaneous causes Two fractures were definitely spiral Oblique fractures were about twice as frequent as transverse fractures Nine cases were complicated by other fractures (Table III)

TABLE III

CONCOMITANT FRACTURES IN NINE INSTANCES IN PATIENTS OVER 15 YEARS OF AGE

Case 1 —Acromion process of scapula
Case 2 —Rib
Case 3 —Pelvis
Case 4 —Upper extremity of femur, through base of neck, same side
Case 5 —Upper extremity of tibia into knee joint, same side
Case 6 —Shaft of tibia and fibula, middle third, and fifth metatarsal, same side
Case 7 —External cuneiform and fifth metatarsal, same side
Case 8 —Base of skull, mandible, patella and os calcis, opposite side
Case 9 —Dislocated shoulder, supracondylar fracture of femur, opposite side, both patellae, both fibulae, upper third of shaft

The first definitive treatment was with ice tongs in 24 instances, Steinman pin in the lower end of the femur in one, and in the upper end of the tibia in one, adhesive plaster traction in six Plaster of paris encasement was not employed in any case as the initial treatment We believe that satisfactory reduction cannot usually be maintained following manipulation and, even if it is primarily good, the danger of slipping later within the plaster encasement is too great Adhesive plaster traction was satisfactory in three and unsatisfactory in three instances Tongs were substituted in two of these cases The third refused skeletal traction and was reduced and immobilized in a plaster encasement The final treatment was skeletal traction in 28 instances, adhesive plaster traction in three, reduction and plaster encasement in one

The initial weight applied with skeletal traction varied from 15 to 40 pounds as follows Fifteen, twice, 20, 5, 25, 5, 30, 4, 35, 8, 40, 1, not recorded, 3 The greater weights were kept on for periods varying from two hours to two days and then reduced Fifteen pounds was the usual weight employed for continued extension Except for one patient, from whom the tongs slipped on the eighteenth day and adhesive plaster traction was substituted, skeletal traction was removed at periods varying from 30 to 92 days and averaging 53 days Plaster of paris encasement was applied on removal of the traction in two instances, adhesive plaster traction in 24, and no further immobilization twice

The wounds from skeletal traction remained clean in 14 and became infected in 14 instances Discharge from tong wounds at any time, no matter how superficial, is classed as infection In ten instances the condition was evidently a soft part infection only, as it cleared up promptly after the tongs were removed and remained healed In four instances we believe there was bone infection as a result of the insertion of tongs In one case a tong wound did not remain healed until one year after their removal, in another not until 20 months later One was unhealed when last seen, two months after removing the tongs, and another 31 months later This patient had been in another hospital twice for treatment of the tong wounds This is an incidence of 14 per cent of bone infections from tongs, prolonging the period of treatment in each instance

In the 24 skeletal traction patients to whom adhesive plaster traction was applied after its removal, the time at which all traction was removed is not charted in one case, in the remaining 23 it varied between 44 and 118 days, and averaged 82 days In the three cases treated entirely with adhesive plaster traction, all traction was removed at 31, 57 and 165 days Almost every patient used a hinged walking caliper after traction was removed One patient had a refracture through the same site on the ninety-ninth day and another had a bone transplant from the tibia on the seventy-eighth day because of delayed union

We know that 29 of these patients obtained solid union, although the time of its earliest appearance is not stated on enough charts to make it informative One patient was discharged in a plaster encasement after 29 days and lost track of One was not seen after the sixty-third day when he was using crutches without weight bearing He was said to have had firm union on the fifty-seventh day The remaining patient was discharged on the sixty-sixth day and lost track of There was no reason to expect a nonunion in any of these three patients from their progress up to the time of their discharge, or as a result of the position of the fragments

The time of appearance of callus in the roentgenogram is mentioned on 28 charts, and averaged 36 days The earliest was 15 and the latest 66 We believe that the average figure is materially less than 36 days since, after the position and weights used had reached a stable point, roentgenograms were not always taken frequently In nine instances callus was visible in less than four

weeks, and we believe this probably approaches more nearly the correct figure The time of appearance of firm union is mentioned on 25 charts, varying between 23 and 88 days, averaging 54 days

The time at which the patient was allowed to walk wearing a walking caliper splint is mentioned on 23 charts One was at 155 days in a case which refractured at 99 days, another was at 159 days in a patient in whom a bone graft was inserted at 78 days and a third at 193 days in a patient who was treated, from the start, by adhesive plaster traction and who had delayed union The remaining 20 commenced walking at periods varying from 70 to 162 days, averaging 103 days

The time at which free weight bearing without caliper support was begun is mentioned on 15 charts One patient commenced walking at four months, against advice, and obtained an excellent result In another patient no caliper was used, weight bearing was commenced at five and one-half months and a refracture occurred at nine months Omitting these two, free weight bearing was allowed at times varying from seven to 13 months, averaging ten months

Our knowledge of exact late results is limited Most of these patients were compensation cases who were cared for by the insurance companies after discharge We know that in some instances the patient was told that if he returned to our Follow-up Clinic he would be cut off compensation If a patient usually is not walking without his brace before ten months, the final functional result will not be obtained before one and one-half to two years We were not able to follow many of our patients for this length of time Attempts to locate them later were rarely successful, as they could not be found, having changed their residences and left no forwarding addresses

We have a record of shortening in three patients only, three-quarters, one, and one and one-quarter inches, respectively Ten patients we know had an A_4, result One was given A_3, on account of abduction of the upper fragment resulting in an external angulation In the remaining 18 we have no anatomic result except that which was inferred from their last roentgenogram while under treatment

Complete function at the knee joint is recorded in six cases Other functional results are shown in Table IV

Late function of the knee joint was not recorded in the remaining 18 patients

We believe that skeletal traction is a satisfactory method of treatment for fracture of the middle third of the shaft of the femur At present we would use Kirschner wire through the lower end of the femur for this purpose instead of ice tongs or a Steinman pin Manipulation under anesthesia followed by plaster encasement is rarely a satisfactory method of treatment Adhesive plaster traction with a Thomas splint is usually ineffective

Lower Third—These are placed in a separate group, because of the usual posterior angulation of the distal fragment, requiring different management Fractures of the condyles are not included

There were ten patients in this group, nine males and one female Their ages were Up to 15 years, 4, 15 to 29, 3, 40 to 50, 1, 50 to 60, 1, 60 to 69, 1 Two were compound, two comminuted and one greenstick Five patients were struck by automobiles and three fell from a height In one instance the shaft was driven down between the fragments, splitting them entirely apart One patient had, in addition, a fracture of the clavicle and five ribs and another gunshot wounds of the foot and forearm

In all except the greenstick fracture the typical tilting backward of the proximal end of the distal fragment was present In only three of these nine

TABLE IV

At six months
180 degrees to 90 degrees
180 degrees to 75 degrees
175 degrees to 90 degrees
At nine months
180 degrees to 75 degrees
At ten months
170 degrees to 105 degrees
At eleven months
180 degrees to 140 degrees
At eighteen months
180 degrees to 90 degrees
At two years
180 degrees to 60 degrees

patients was it believed that this angulation was completely reduced, although in all the others it was so markedly improved that a good weight bearing axis was to be expected The original angulation was as much as 45 degrees in some instances

As first definitive hospital treatment, three children had reduction followed by application of a plaster spica, five had adhesive plaster traction with a Thomas splint suspension, the weight varying between 18 and 30 pounds, one, tongs in the femur (30 lbs), and one a Steinman pin in the tubercle of the tibia (20 lbs) No open operations were performed primarily The adhesive plaster traction treatment was unsatisfactory twice and later Steinman pins were inserted in the tubercle of the tibia with 30 and 35 pounds weight applied Skeletal traction was, therefore, used four times This was removed in from 33 to 55 days, an average of 40 days, and adhesive plaster traction usually substituted All traction was removed in from 53 to 104 days, and averaged 71 days Four patients were using walking caliper braces before discharge from the hospital One Steinman pin wound became infected but healed one week after removing the pin

We know that solid union occurred in eight patients, nonunion in one, and one could not be followed after the sixtieth day, at which time he was walking with a caliper brace and had had firm union since the thirty-fifth day

The case with nonunion is of particular interest in showing the possible value of the use of a walking caliper late in the treatment The patient was

a Chinese, age 50, who was treated in suspension with a Steinman pin through the crest of the tibia The weight was changed three times in the first 18 days in an attempt to improve the position The alignment was good at the end of this time The pin was removed on the fifty-fifth day and adhesive plaster traction substituted Firm union is said to have been present on the sixtieth day Traction was removed on the one hundred fourth day and he was allowed out of bed with a brace on the one hundred sixth day He was discharged on the one hundred twenty-sixth day, walking well on a caliper with crutches He stated later that he removed the splint as soon as he reached home Shortly thereafter he felt the bone snap However, he continued to bear weight without the caliper but with crutches He failed to return for five months, at which time he had a definite false point of motion and the lower fragment of the oblique fracture was displaced proximally for about one inch and angulated outward About ten months after injury a periarterial femoral sympathectomy was performed and the extremity was immobilized in a plaster spica with the fragments in fair alignment There being no evidence of progressing union, 12 months after injury an open reduction with Lane plating was effected The wound became infected and the plate was removed nine weeks after operation A false point of motion was still present eight months later and the patient had a draining sinus

The time of appearance of callus in the roentgenogram is mentioned on eight charts, varying between 21 and 100 days, averaging 42 days The time of appearance of firm union is noted on seven charts, varying between 28 and 80 days, averaging 42 days

We have the late results on six patients Four were A_1, E_4, F_4, three of these being children One was A_4, E_0, F_4, the opposite leg having been amputated previous to this injury One was A_3, E_4, F_3, having some angular deformity and an indeterminate functional loss since he had a previous bony ankylosis of the knee joint He was a peddler by occupation and was doing the same work at 13 months Except for the three children, one A_4 result was treated by reduction and plaster encasement and one by ice tongs

Closed reduction with the application of a plaster encasement was satisfactory in children We believe immobilization in a plaster encasement usually offers little in adults We found no method of traction generally satisfactory in adults and believe that open reduction should be used more frequently If for some reason open operative reduction should not be performed, we favor skeletal traction by a Kirschner wire through the lower end of the femur, or through both the femur and the tubercle of the tibia, the latter to give traction and the former to overcome the posterior angulation Adhesive plaster traction should not be used

SUMMARY.—(1) One hundred-twenty consecutive patients with fracture of the shaft of the femur are considered

(2) Seventeen early deaths are discussed, 14 of these being in multiple severe injuries Three cases requiring amputation are discussed, one of whom died These deaths and amputations are omitted from the rest of the study

(3) One hundred one patients remained for more detailed analysis of treatment Forty-eight of these were under 16 years of age Forty-seven were the result of motor car accidents There were but four compound and 20 comminuted fractures

(4) Seventeen fractures were in the upper third, 74 in the middle third and ten in the lower third The three groups are discussed separately

(5) The primary hospital treatment was adhesive plaster traction in a Thomas splint suspension (43 cases), skeletal traction (35 cases), overhead adhesive plaster traction (11 cases), reduction and application of a plaster spica (11 cases), and open reduction (1 case)

(6) The initial treatment was unsatisfactory in 14 patients with adhesive plaster traction suspension and in two following reduction and application of a plaster spica

(7) The final treatment, except for complications, was skeletal traction, 43, adhesive plaster traction in a Thomas splint suspension, 31, plaster spica, 12, overhead adhesive plaster traction, 11, and open reduction, 4

(8) Traction methods were employed in 84 per cent of these patients

(9) In the skeletal traction cases tongs were removed after an average time of 49 days

(10) In adults, where traction only was used throughout the entire treatment, this was all removed after an average of 75 days

(11) In the use of skeletal traction there were 21 infections in 42 patients Fourteen of these healed promptly after removal of the tongs or pin Seven, or 17 per cent, discharged for a long enough period so that we must consider that infection of bone was present

(12) There were four early open reductions, three in simple fractures and one in a compound fracture All were in children One had no internal fixation, one kangaroo tendon, one wire, and one a steel plate The compound fracture became infected, followed by osteomyelitis, but solid union occurred The others remained clean The incidence of open operation in children was eight per cent

(13) Four patients sustained refractures, on the fifty-sixth, seventy-first and ninety-ninth days after injury, and one outside the hospital at nine months

(14) Three patients had late open reductions for complications One had an open reduction with steel plating on the seventy-sixth day for a refracture on the seventy-first day Another had a bone transplant from the tibia on the seventy-eighth day for delayed union The third had an internal fixation with a steel plate one year after accident for nonunion The first two remained clean The last became infected with persistent nonunion

(15) There was one death during treatment This occurred from embolism in a patient while in skeletal traction

(16) Of the remaining 100 patients we know that 84 obtained solid union and one nonunion The other 15 could not be followed, but there was no

reason, from the position of the fragments or the progress when last seen, to expect nonunion in any of these

CONCLUSIONS

By these methods of traction, bony union with relatively little shortening and good functional results may be obtained in a high percentage of cases Until our results were closely analyzed we had believed that they were good They are not good enough Overhead adhesive plaster traction was satisfactory in children under five years of age Skin traction was unsatisfactory in children over five years of age from the point of view of recovering original length Skeletal traction in adults gave too high an incidence of infection Therefore in March 1932, we changed to the use of Russell traction in all these groups Sallick[1] has recently reviewed our experience for three years with this method We are still not satisfied and believe that, in spite of the objections noted in the early part of the paper, we should perform more open reductions with internal fixation This is particularly true in transverse fractures of the middle third and in most lower third fractures Skeletal traction has been a marked improvement over reduction and application of a plaster spica or adhesive plaster traction with the Thomas splint No single method of treatment will apply to all cases and one should be ready to employ each type of treatment according to the individual indication

REFERENCES

[1] Sallick, M A Fractures of the Femur treated by the Russell Traction Method Surg, Gynec, and Obstet, 64, 103 1937

[2] Kennedy, R H Emergency Treatment of Extremity Fractures New England Jour Med, 207, 393, 1932

[3] Kennedy, R H Transportation of the Injured Bull Am Coll Surg, 17, 21, 1933

DISCUSSION —DR KIRBY DWIGHT (New York) said that one could not have listened to Doctor Kennedy's paper without realizing that the treatment of fracture of the femur has not yet become standardized or stereotyped There has been a gradual, continual improvement, however, when one considers it in retrospect Probably the history starts with what was called Buck's extension with a little railroad on the bed and with most of the traction applied to the bed Then there was the period of the bone surgery when Lane plates were used, which can be subdivided into two periods, first the Lane plate with infection period, then the Lane plate without infection The development of the Lane technic made a tremendous difference in that regard Next came suspension and traction, with adhesive first, followed by skeletal traction by the three methods so commonly in use today The Steinman pin, the calipers or ice tongs, and the Kirschner wire Finally, there evolved Russell traction, on which so many looked skeptically at first only to embrace it for use in a good many types of fracture During the 20 years' experience just reviewed, a good many other elaborate pieces of apparatus were developed for the treatment of this type of fracture, but in general, they were not adopted by surgeons It was largely a question of expense in hospital work, presumably

In the field of skeletal traction, the matter of the Steinman pin versus the Kirschner wire is current The speaker personally regarded the latter as

far superior on account of the danger of infection with the pin After the World War Doctor Dwight was stationed for some months in a hospital that cared for the soldiers returning with bone injuries He learned a great deal about the healing of bone in the presence of infection, and one of the basic principles—in fact, one of the great truths in the treatment of old, infected compound fractures—is that a cavity or tunnel in bone that is larger than a certain minimum size cannot heal It cannot because it cannot be first filled with healthy granulation tissue The granulations forming on bone can reach only a certain thickness before their base becomes constricted by scar tissue, the blood supply to the surface becomes too little to combat infection, and there is unhealthy granulation tissue which continually discharges pus Now the diameter of the Steinman pin, plus the thickness of the area of necrosis in infected cases, gives one a tunnel through the bone, the caliber of which is too large to be filled with healthy granulation tissue when the pin is removed This is probably the main reason why the Kirschner wire does not behave that way namely, because of its very much smaller diameter

Regarding fractures in children between the ages of five and ten, the results are rather poor, poorer than in the years below five, or over ten Bryant suspension is very satisfactory in young children up to the age of five Above that age, there is a change in the child's physiology He is no longer a baby, but a very active young animal whose activity puts on strength of muscle and takes off superfluous flesh so that the child of seven, for instance, has much greater strength of muscle in proportion to weight than has the four year old child Therefore, in Bryant vertical traction, using both legs, the weight of the body is not sufficient to reduce the fracture On the other hand, one cannot apply that traction to one leg because the child moves all around in bed, so that there is no immobilization of the fracture At the same time, methods used in adults do not seem satisfactory in children of this age They are pulled right down in the bed for the same reason namely, that their body weight is light in proportion to the strength of their muscles

One method used by Doctor Dwight for a good many years, the most satisfactory in his experience, is suspension by one leg at an angle of 45°, up to the frame above the foot of the bed, at the same time elevating the foot of the bed itself so that the body slides backward and traction is partly upward, so that one can get some of the effect of the Bryant traction, and partly longitudinal, so that the child is not twisted around from a traction applied to one leg Doctor Dwight has used a sling as a kind of coaptive splint to suspend the thigh, and it need not extend below the knee In general, he was in hearty agreement with the conclusions reached by Doctor Kennedy, with whom his experience largely coincided In all cases that he can, Doctor Dwight uses Russell traction In those where it is not successful he uses the other methods just stated He has had some experience with fractures of the lower end of the shaft with angulation backward of the lower fragment In one case treated with calipers he got the calipers a little high (calipers can act just as badly as the Steinman pin if one gets them in too far and a deep hole is made in the bone) and on account of the shape of the calipers the traction could not be purely longitudinal, but was upward and longitudinal The immediate result was that it reversed the type of displacement, the proximal end of the distal fragment was brought anterior to the distal end of the proximal fragment Doctor Dwight thought a long time as to what to do about that Finally, experimenting, he saw that the caliper points were above the axis of rotation of the lower fragment So he hung a weight on the pins of the caliper just as they emerged from the thigh, and was able to adjust the weight so that the lower fragment swung back into position

DR PHILIP D WILSON (New York) said that any study of results in a series of cases is of value chiefly when one makes a comparison with a similar group of cases Such a study was available in the comparison of a series of 130 cases which had been analyzed from the Fracture Service of the Massachusetts General Hospital, with which he had been formerly associated, which cases had been treated in approximately the same manner

Using 15 as the dividing age, there were about 50–50 adults and children The main complications were Slipping of the ice tongs, five cases, breaking of plates after operation, three, and postoperative sepsis, eight out of 26 open operations Doctor Wilson thought that Doctor Kennedy had been well advised in his conclusion that because they were dealing with a large series of cases brought in off the streets—potentially infected—open reductions had been kept down to a minimum In the series mentioned by Doctor Wilson there were 105 end-results obtainable in the 130 patients There was shortening in 15 7 per cent of the children and in 30 per cent of the adults, but this shortening was not a measurement made at the time of the patient's discharge from the hospital, but a year—often two years—after discharge, when the patient returned for end-result observation In some instances, it was made three years after discharge To this difference in time of observation Doctor Wilson attributed differences in Doctor Kennedy's end-results and those found in his own series Doctor Kennedy's chief difficulty was in children Doctor Wilson thought he had not followed them long enough The bones in children have a potentiality toward correcting deformity by growth Cases of children discharged with no shortening may come back a year or two later with the leg an inch or so longer This is not an argument to strive for shortening, but it is one against the endeavor to be too perfect In general, children will give a good account of themselves

Doctor Wilson defended the one leg overhead traction in small children, if the child is fixed on a Bradford frame so that he cannot wriggle around It is desirable to get as much counter traction as possible If the child is spring-boarded there is only half the counter traction one obtains when only one leg is slung up

DR CLAY RAY MURRAY (New York) emphasized two points made by Doctor Kennedy One, that he was careful to define the type of hospital in which the results were analyzed, and secondly, he described the type of cases treated in that hospital His conclusions, as drawn for such a situation, are accurate and could hardly be improved on Doctor Murray also approved Doctor Kennedy's statement that the probability is that, in fractures of the shaft of the femur under modern conditions, the ideal form of treatment is open reduction with early mobilization of the fracture However, it is inadvisable to pursue such a course of treatment under ordinary conditions

The truth of these two theories is rarely accepted, and it is regrettable that the method of treatment acknowledged as the right approach to the ideal under proper conditions is considered inaccessible in all except a very few select situations Therefore, it is concluded that the less ideal methods should be employed in most instances Doctor Murray thought that it was about time, with the development of surgical technic, that the difference between incidence of infection with the use of Kirschner wire over the Steinman pin is extended to the operative handling of fractures If some of the time and individual effort that are put into finding means to avoid operating upon fractures, were to be put into finding means to make hospitals provide equipment and the organization to make such work safe, the disability after fractures of the long bones would materially decrease

DR FENWICK BEEKMAN (New York) said he had no idea that children comprised such a large number of cases in a series of fracture of the shaft of the femur His personal experience had, however, been almost entirely with children, many of the cases having been admitted to the Children's Surgical Service at Bellevue Hospital Here Russell traction had been employed for fracture of the femur in children for about the same period of time that Doctor Kennedy has used it at Beekman Street Hospital Previous to 1932, when Doctor Beekman first commenced to use this method, children under six years of age were treated by overhead traction (Bryant traction) and older children were given an anesthetic, put on a Hawley table, the fracture reduced, and a circular plaster encasement applied from the hips down to the ankle, not including the foot Skin traction having been previously attached, the traction was now applied by means of weights on the skin traction The idea of this treatment was that the fracture was reduced by means of the Hawley table, and the plaster encasement and traction were used to keep the fragments in position The results of a large number of children treated by this method have been reported by Dr Carl Burdick With the advent of Russell traction, this former method, in older children, was discontinued and the Bryant traction was applied only to children under three years of age

Doctor Beekman favored Bryant traction applied to both legs, although he can remember some years back that it was frequently used on only one leg Suspension, however, by both legs did not always keep the child quiet, as he had often seen a child, even at the end of a few weeks, with the two ropes twisted, having rotated the body three or four times He did not believe that it was necessary to immobilize the pelvis in using Bryant traction

He wished to stress the point which Doctor Kennedy had mentioned, that the traction does not, of necessity, reduce the fragments in fractured femora In his experience he had found that hardly a child with Bryant traction had a perfect anatomic reduction, unless an anesthetic had been given and the fracture reduced before the suspension was applied Doctor Beekman believed that this was also true of Russell traction In most of the cases which had come under his observation, although much callus had developed, the fragments had not always been brought into exact end-to-end contact Though union occurs with slight angulation, unexact alignment and some over-riding, the end-results after two or three years are excellent At this time it is often impossible to tell by means of physical or roentgenologic examination which of the femora had been fractured He had made the statement that, after reviewing a large series of cases, he felt that good anatomic and functional results could be obtained in almost all cases, even though there might be over-riding and lack of alignment of the fragments

Doctor Beekman did not approve of open reduction in children Out of some 200 cases of fracture of the shaft of the femur in children which he had seen during the last ten years, there had been but two open reductions performed in the Children's Surgical Service at Bellevue Hospital, and both of these were undertaken because of nonunion caused by the interposition of the muscles

In discussing the length of time a child should be kept off his feet, Doctor Beekman said that he kept the patient in traction about an average of 42 days and then in bed, without splints, for about two weeks, after which the child was sent home with instructions to the parents that it be kept in bed Though these instructions were always given, Doctor Beekman did not believe that they were always carried out, for in so many cases he found that as soon as the child left the hospital he was up and around Even while still in the hospital, children who have just had traction removed have often been

seen to get out of bed and run about, but in none of these cases were there disastrous results In the healing of fractures in children there is a great deal of callus thrown out In Doctor Beekman's experience at Bellevue during 15 years, there were only about three instances in which refractures occurred in the femur

The speaker thought it was timely that the subject of fractured femora should be brought before the profession, as the methods of treatment which have been recently introduced, such as Russell traction, have been far more satisfactory than those previously employed He agreed with Doctor Murray that a surgeon should have recourse to more than one method of treating any particular type of fracture, as there were no two cases alike Therefore, all cases cannot be treated in the same manner A properly trained surgeon does not use standardized methods, but uses his judgment as to the best form of procedure to use in each particular case

DR JOHN A MCCREERY (New York) thought it interesting to compare Doctor Kennedy's figures with those taken from the First Division at Bellevue Hospital, although these do not include children There have been 150 fractures of the shaft of the femur treated on the First Division during the last 15 years, with a mortality of 14 per cent (21 deaths) This high mortality emphasizes the fact that fracture of the shaft of the femur is a serious injury with a high death rate due in part, perhaps, to the fact that in many of these cases there are complicating injuries Seventeen deaths were early, the others occurring after varying periods of time, mostly as a result of infection One hundred thirty-eight of the Bellevue fractures were simple, 18 compound, two of the latter being due to bullet wounds In these the fractures were by impact rather than from penetration of the bone which was found in the high velocity war wounds It was interesting to note how the type of treatment had gradually changed during the 15 years At the start a good many cases were placed in a plaster encasement Skeletal traction was then employed, first with the Steinman pin, then with ice tongs, and finally with a Kirschner wire Doctor McCreery had had much the same trouble with infection in cases where tongs and pins were employed as did Doctor Kennedy in his series Recently, Russell traction has been employed with increasing frequency, and with the same satisfactory results as noted by Doctor Kennedy He was surprised to note how often open reduction had been resorted to in the series analyzed, his percentage fell between those reported by Doctor Kennedy and Doctor Murray The usual method of immobilization has been with Lane plates Seven of the 150 cases had come to amputation, most of these had been compound fractures involving the knee joint and in which infection had developed Five cases had refractured, in all of these there had been some underlying pathologic condition such as bone cyst, Paget's disease or metastatic tumor

WATER BALANCE IN NEUROSURGICAL PATIENTS

J C WHITE, M D, W H SWEET, M D, AND E S HURWITT, M D
BOSTON, MASS

FROM THE SURGICAL SERVICES OF THE MASSACHUSETTS GENERAL HOSPITAL AND THE SURGICAL LABORATORIES OF THE HARVARD MEDICAL SCHOOL AT THE MASSACHUSETTS GENERAL HOSPITAL, BOSTON, MASS

IN ANOTHER article[1] attention has been called to the volume of blood lost during operations upon the brain, when a large bone flap is turned down This is from two to five times the amount ordinarily shed in operations on the intra-abdominal and intrathoracic viscera In addition to this excessive hemorrhage, which averages from 500 to 1,500 cc, the patient undergoing a prolonged operation for an intracranial tumor may lose up to 1,000 cc of water from his skin and lungs As a result of this loss of fluid from the vascular bed, sweat glands, and lungs, these patients often become seriously dehydrated

The importance of transfusion during and after severe neurosurgical operations is generally appreciated, but in addition to this an understanding of water exchange is of practical value, because the replacement of fluid must be regulated with greater care after operations within the cranial cavity The comatose patient is unable to drink, so that fluid intake must be regulated by the surgeon Solutions administered intravenously or subcutaneously have a greater tendency to produce edema than liquids taken by mouth If a slight excess of saline or glucose solution is infused after routine celiotomies, the resultant mild edema is not necessarily serious But in operations upon the brain there is considerable tissue trauma, and a local increase in capillary permeability ensues In addition to this, after a period of coma and malnutrition, the protein content of the plasma may already be reduced, with the further loss of protein contained in the liter or more of blood lost at operation, conditions for the production of cerebral edema are optimum Swelling of the brain causes an obstruction to the outflow of blood from the venous sinuses and an increased production of cerebrospinal and edema fluid—a vicious cycle which may lead to death

The purpose of this and another article[1] is to show the quantity of blood and other fluids commonly lost in the standard neurosurgical operations, what can be done to reduce this, and how the disturbed fluid balance can most effectively be restored

Fluid Loss from Lungs, Skin, and Kidneys—Rowntree,[2] and more recently Underhill[3] have reviewed the literature on water metabolism, accurate measurements of water balance in human beings have been made by Newburgh and his associates[4] These studies have been applied to surgical patients by Coller and Maddock,[5, 6, 7] and there would be little justification for an investigation on the special aspects of water balance in neurosurgical pa-

Submitted for publication August 16, 1937

tients were it not for the fact that the total fluid loss in these cases is greater than any which has been reported heretofore In order to recall the mechanism of postoperative water balance and to bring out its application to the special field of neurosurgery, we shall have to review very briefly the pertinent findings of the writers above mentioned and then record our determinations on this particular group of patients

In healthy individuals, as well as in patients recovering from neurosurgical operations, there are three principal channels for the excretion of water (1) Water in urine, (2) water in feces, and (3) water vaporized from skin and lungs

Excessive fluid loss from diarrhea, vomiting, and draining wounds is fortunately such a rare complication after neurosurgical operations that it need not be considered here

Water in the Urine—Water excreted by the kidneys removes waste products from the blood, as well as certain substances such as sodium chloride and glucose present in excess of their normal threshold In this connection it is important to point out that water is available for kidney secretion only after the skin, lungs, and intestinal tract have taken up their prior rights A person on a low fluid intake in an excessively hot environment, or a patient with fever, vomiting, or diarrhea may become anuric when approximately 6 per cent of the body weight has been lost as water During the recovery period after operation Coller and Maddock[6] recommend that the 24-hour volume of urine be maintained at a minimum of approximately 1,500 cc, with a specific gravity below 1 015 In dealing with patients after operation on the brain, where the possibility of cerebral edema is a constant source of danger, this would seem to be an unnecessarily generous estimate It is our opinion that with normal kidneys a daily urine output of 800 to 1,000 cc is sufficient, provided the specific gravity remains below 1 025 With a high fever or when renal function is impaired, a larger volume is required Frequent determinations of the nonprotein nitrogen level in the blood are an ample safeguard against renal insufficiency We have come to rely far more on the level of the nonprotein nitrogen than on the urinary volume or specific gravity The latter may be distinctly misleading when intravenous fluids are administered For example, when salt solution is given to a postoperative patient, much of the fluid may be retained in the interstitial spaces as edema The tissues, therefore, may become overhydrated, while the kidneys are eliminating only a small volume of urine with a high specific gravity due to the increased concentration of sodium and chloride ions

Water in the Feces—Rowntree[2] has estimated that from 7 5 to 10 liters of fluid are poured into the gastro-intestinal canal daily by the salivary glands, the mucosal glands of the stomach and small intestine, and in the biliary and pancreatic secretions In the normal individual nearly all of this is reabsorbed in the colon, so that in the absence of diarrhea, water lost in the feces rarely amounts to more than 200 cc a day The stool of normal consistency contains 50 to 80 per cent water

The Insensible Loss of Water *—The third way in which water is eliminated from the body is by vaporization from the skin and lungs Water lost in this way constitutes a most important part of the heat regulatory mechanism In sick postoperative patients and in the presence of fever or extreme heat, the loss of water by this channel is frequently greater than in both the urine and feces The extent of this loss, which the average surgeon leaves out of his calculations, is important because it continues even in advanced dehydration Water continues to be vaporized from the skin and lungs even if none is left for kidney function Water eliminated in this way accounts for the major part of the insensible loss of body weight, the other component being the weight of carbon dioxide exhaled in excess of the weight of oxygen absorbed Since vaporized water may compose anywhere from 85 to 100 per cent of the total insensible loss of body weight, the error of assuming the insensible weight loss to be made up entirely of water is never great

Newburgh, Wiley, and Lashmet[4] have found that normal individuals at comfortable environmental temperatures, and when performing only light work, vaporize an average of 1,000 to 1,500 Gm of water daily Under strenuous muscular exertion, during fever, or at temperatures over 80° F, the sweat glands become active and an increasing amount of water is vaporized to maintain a constant body temperature

During the period of operation and the first few days thereafter, the amount of sweating is greatly increased Fortunately in the course of craniotomies, especially when ether is not used, patients do not sweat as profusely as during the average celiotomy (Tables I and II) While the insensible loss, expressed as grams of water vaporized for each square meter of body surface per hour, is much less than in the routine celiotomy, the entire loss over the three to four hour period of operation may be approximately the same or somewhat more Table I records the insensible weight loss in six patients during the course of intracranial operations Patient 28, where ether was used, lost 1,012 Gm This is 30 per cent greater than the highest recorded loss in Coller and Maddock's statistics, and occurred in spite of the fact that the lightest possible drapes were used Patient 29, who underwent a more serious operation under avertin and local anesthesia, vaporized 574 Gm In this patient, however, the huge additional loss of blood (2,050 cc) resulted in the maximal total fluid loss of the series The other four eliminated water vapor at a distinctly less rapid rate than major general surgical cases, although the longer operative period resulted in a total insensible weight loss almost as great as that observed in Coller and Maddock's cases (Table II)

* The detailed method of measuring the insensible loss of water is beyond the scope of this article This has been described by Coller and Maddock[5,6] Briefly, the patient is transferred from bed to a delicate balance at the end of each period of observation Over this interval all ingesta and excreta are accurately weighed The total insensible loss of weight for each period is calculated by the following equation Beginning Weight — (End Weight — Ingesta + Excreta) Since the Insensible Loss is measured by weighing the patient, it is better recorded in grams than in cubic centimeters

TABLE I

FLUID INTERCHANGE DURING PERIOD OF OPERATION*

Patient No	Operation	Length of Operation—Hours	Period of Calculation—Hours	Anesthetic	Blood Loss	Vomitus	Urine	Insensible Loss and Sweating	Insensible Loss and Sweating—Gm /M²/Hr	Total Fluid Loss
7	Bone flap to evacuate subdural hematoma	2½	3¼	Local and ether	599	0		223	51	822
8	Resection of meningioma of tuberculum sellae	2½	6	Local	573	0		241	28	814
13	Partial section of fifth cranial nerve root	1	4	Local and evipal	86	0		127	22	213
28	Partial removal of chromophobe adenoma of pituitary	2⅓	4⅔	Avertin-ether and novocain	1,200	0	113	1,012	109	2,325
29	Subtotal resection of meningioma of wing of sphenoid invading orbit	2½	4½	Avertin and local	2,050	0		574	61	2,624
32	Myoplastic craniotomy for oxycephaly	1¼	4	Avertin-ether and novocain	487	0	32	148	23	635

* All fluid measurements are recorded in grams, except blood loss, which is given in cubic centimeters The operations were all performed in cool weather, with the operating-room temperature between 75° and 78° F In patients Nos 7, 8, 13, and 29 the urine was not obtained at end of operation, but was measured over the entire day

TABLE II

FLUID LOSS DURING GENERAL SURGICAL OPERATIONS

Statistics of Coller and Maddock[5]

		Grams	Insensible Loss Gm /Sq Meter/Hour
1	Partial gastric resection	533	127 5
2	Excision thyroglossal cyst	313	82 3
3	Exploratory, kidney	233	71 9
4	Repair inguinal hernia and appendicectomy	666	152 6*
5	Repair ventral hernia	328	88 3
6	Excision sarcoma of thigh	245	121 6*
7	Excision teratoid tumor of abdomen	180	62 2
8	Radical mastectomy	705	193 8
9	Partial gastric resection	560	149 8*
10	Colostomy	97	66 7
11	Repair inguinal hernia	259	167 6*
12	Repair ventral hernia	115	65
13	Hemorrhoidectomy	92	51 8*
14	Repair inguinal hernia	192	40 2
15	Appendicectomy	166	116 1*
16	Cholecystectomy	40	15 *
17	Appendicectomy	137	84 2*
18	Repair ventral hernia	347	113 9*

* Cases where ether was used

These observations were made over a four-hour postoperative period

The insensible weight loss during the early days after operation was measured in seven patients Typical examples are given in Tables III and IV, which record the postoperative determinations after a myoplastic subtemporal decompression (Patient 32), and following a difficult removal of a large meningioma of the wing of the sphenoid (Patient 29) In Patient 32 the insensible loss after operation never rose above 1,561 Gm per diem, the upper limit for a normal individual of 57 kilos In Patient 29 over 2,700 Gm of water were vaporized during the day after operation As the temperature rose from 101° to 107 5° F, the loss from the skin and lungs diminished, because of the retention of heat which necessarily accompanies a rapidly rising fever *

It is unfortunate for the surgeon in charge of the postoperative care of such a difficult case that there is no accurate index of early dehydration Beyond the well known clinical signs, the most important laboratory data are (1) Urine volume and specific gravity, (2) red blood count, hemoglobin, and hematocrit determinations, (3) serum protein, (4) nonprotein nitrogen, (5) body weight, and (6) blood volume

We have depended on the first four tests, which are applicable to routine surgical patients, but wish to make it clear that none of these is infallible until

* This is only true over the period in which heat is being retained and the body temperature rising When the fever is stationary or falling, the elimination of water from the skin and lungs is commonly increased

TABLE III

PATIENT 32 MYOPLASTIC CRANIOTOMY FOR OXYCEPHALY

T B age 17 a mild oxycephalic complained of headaches and diminishing visual acuity Roentgenograms revealed complete closure of all his cranial sutures and deepened convolutional markings indicative of a chronic increase in intracranial pressure His visual acuity was diminished to 20/200 in each eye There was moderate pallor of each optic disk but no evidence of choking His intelligence was nearly normal The spinal fluid pressure was found to be slightly over 200 Mm on two occasions Decompression was recommended to reduce his headaches and to preserve vision

2/23/37 A right myoplastic subtemporal decompression was performed by Doctor White removing bone over a diameter of 6 cm 1 244 Gm of 5 per cent glucose in normal saline was administered during and after the operation but there was no need for a transfusion Blood loss at operation amounted to 487 Gm

The patient made a satisfactory convalescence There was only a slight febrile response He was able to take fluid by mouth from the beginning and to eat solid food on the second day Readjustment of his water balance after operation was therefore a relatively simple matter calling only for the limitation of fluids to approximately two liters during the first three days The reason for this patient s low serum protein (5 5 to 4 6 per cent—Table V) was never explained With the resultant reduction in the colloid osmotic pressure there would have been a serious risk of cerebral edema if the patient had been comatose and required prolonged venoclysis (see protocol on Patient 30 below) There was no cause for concern here however as there had been no operative trauma to the brain and the patient was able to take a normal diet within three days

	Weight of Patient without Dressing	Water Drunk	Intravenous	Food Water Water of Oxidation Medications	Urine	Specific Gravity, N P N	Stool	Vomitus	Blood	Insensible Loss and Sweating	Maximum Mouth Temperature	Range of Room Temperature	Total Fluid Intake	Total Fluid Output	Fluid Balance
Preop 2/12–2/13/37	57 570	904	0	1 277	727	1 026	196	0	0	1 368	101 0°	74 ⟷ 72	2 181	2 291	110 —
Preop 2/13–2/14	57 460 56 830	764	0	1 238	872	1 024 N P N 24	204	0	0	1 556	100 2	74 ⟷ 70	2 002	2 632	630 —
Day of Op 2/23–2/24	56 870	794	1 244	323	294	1 032	0	447	487	1 173	100 8	73 ⟷ 72	2 361	2 401	40 —
1st Day Postop 2/24–2/25	56 830	928	1 318	40	1 213	1 019 N P N 17	0	0	32	1 561	100 4	68 ⟷ 65	2 286	2 806	520 —
2nd Day Postop 2/25–2/26	56 310	1 554	0	479	2 326	1 015	0	0	0	1 263	99 9	72 ⟷ 66	2 033	3 589	1 560 —
3rd Day Postop 2/26–2/27	54 750	1 189	0	954	1 891	1 008	0	0	23	939	99 8	76 ⟷ 68	2,143	2,853	710 —
4th Day Postop 2/27–2/28	54 040	1 189	0	1,273	1 176	1 016	0	0	0	1,266	99 0	70 ⟷ 66	2 462	2 442	20 +
5th Day Postop 2/28–3/1	54 060	1 189	0	1 275	1 295	1 019	154	0	0	1,305	99 8	74 ⟷ 68	2 464	2,754	290 —
6th Day Postop 3/1–3/2	53 770 54 070	1 188	0	2 827	1 196	1 021	0	0	0	1,519	99 9	76 ⟷ 70	3,015	2,715	300 +

Weighings all performed at 7 00 A M
The patient's weight and all fluid measurements except blood are recorded in grams Blood lost at operation is given in cubic centimeters

dehydration has reached the advanced stage in which blood volume begins to fall From these criteria, as well as from her clinical appearance, Patient 29 did not appear to be dehydrated (Tables IV and V) Judging from her rapid loss of weight, however, and by her large daily excess of fluid output over intake, we feel that she must have become so Although it would have been impossible to detect this by any tests which can be made outside of a special metabolism ward, we believe that the rules for postoperative fluid replacement which are detailed below are adequate to prevent this dangerous complication without risk of cerebral edema

In concluding this subject of water loss after operation, the importance of the insensible loss cannot be emphasized too strongly, because of its large volume and the fact that, unless it is recognized and adequately replaced, it will continue until no water is left for renal secretion Contrary to what is still assumed by many surgeons, it is impossible to obtain a complete picture of the total water exchange by a comparison of the fluid intake with the urine output An understanding of the way the body eliminates fluid, and the volumes concerned, is essential for the maintenance of an adequate intake in the sick or comatose patient

Methods of Reducing Water Loss —In addition to controlling hemorrhage in the patient on the operating table, it is important to reduce the insensible loss of water from the skin and lungs For this purpose, as well as for the reduction of hemorrhage, it is our belief that ether anesthesia should be avoided whenever possible This statement is borne out by a comparison of the insensible loss per square meter of body surface per hour in etherized and nonetherized patients (Table I), and by observation of the relatively slight degree of perspiration which is commonly present after prolonged craniotomies under local anesthesia

Besides selecting an anesthetic which will not increase the activity of the sweat glands, it is essential in warm weather not to overburden the patient with thick coverings In preparation for operation it is routine practice at many hospitals to cover patients with a blanket and warm leggings, before numerous additional layers of sterile drapes are superimposed on the operating table This practice is pernicious if the temperature in the operating room is over 80° F , Coller and Maddock[5] have shown that the insensible loss of water during operations in hot weather can be considerably reduced when the lightest possible drapes are used In all of our cases in Table I, where the temperature in the operating room averaged between 75° and 78° F , the lightest possible gown, leggings, and drapes were used The same procedures were applied after operation In hot weather a special effort should be made to keep the sick postoperative patient from losing still more of his depleted water supply by sweating

Methods of Restoring Water Loss —In the normal individual the fluid intake and output are so regulated that the water content of the body is maintained at approximately a constant level This relationship may be upset in a surgical patient who is too sick to have a normal sensation of thirst and is

unable to take an adequate amount of fluid by mouth In such a patient the water intake must be regulated by the surgeon, and recovery may depend on how skillfully this is done The fundamental aspects of fluid intake and the replacement of water in dehydration have been discussed by Coller and Maddock,[7] so that only a short review of this subject, with particular emphasis on the special problems which come up in neurosurgical patients will be presented here

In brief, there are two main sources of water intake (1) Water drunk, and (2) food, either eaten in the diet or body tissue consumed

The average adult drinks from 800 to 2,000 cc a day In the water which comes from metabolism there is no distinction between food eaten and body tissue burned The water content of vegetables and fruits averages 80 per cent of their weight, while meats contain from 60 to 70 per cent water There is an additional source of water derived by the process of metabolism known as the water of oxidation Two hundred to 400 cc of water are furnished daily from this source In a mixed diet, each gram of food eaten yields through its water content plus its water of oxidation around 0 9 Gm of water Calculation of the water derived from the routine house diet at the Massachusetts General Hospital eaten by the average patient in a single day shows

Total weight of food		1,885
Water content of food		1,400
Water of oxidation	Protein	29
	Fat	93
	Carbohydrate	133 +
Total		1,655 Gm.

In the house diet listed above are included

Milk	500
Cream	90
Soup	150
Coffee and tea	0 Gm

When the patient is unable to take anything by mouth, the only water available to compensate for the large daily deficit is that coming from the body glycogen, fat, and protein burned for energy This yields about 500 cc daily The interstitial fluid amounts to about 15 per cent of the body weight and constitutes a reserve which can be drawn upon quite extensively in defense of the blood plasma volume without disturbing the organism Moderate reduction of interstitial fluid (dehydration) is harmless and probably desirable, but when up to 6 per cent of the body weight is lost, serious effects begin to develop

The application of these statistics to the restoration of fluid balance after intracranial operations is brought out by the data of typical cases in Table I During the operative period the average patient will lose from 500 to 1,500 cc of blood, and from 200 to 1,000 Gm of water are vaporized from the skin and lungs The secretion of urine during this period is small, averaging less

than 100 Gm during an ordinary craniotomy The total loss of fluid, therefore, is usually more than 1,000 Gm and may even exceed 2 5 kilos Hemorrhage and dehydration are frequently severe enough to require immediate attention, the replacement by infusion or by transfusion, depending on the blood loss and the degree of shock Our customary procedure has been to start an intravenous infusion of 5 per cent glucose in normal saline at the beginning of all extensive operations and to permit 500 to 1,000 cc to run in slowly during the course of the operation As has been described in the preceding article,[1] citrated blood may be substituted for the infusion at any time if there is an alarming fall in the blood pressure When it is estimated that a hemorrhage amounting to a liter or more has taken place, a transfusion is given in the operating room When larger amounts of blood have been lost and the blood pressure remains low, another transfusion is given in the ward By following this procedure the fluid deficit after operation should rarely exceed 1,000 cc The intravenous infusion is continued as the patient is returned to the ward and a total of up to 2,000 allowed to run in slowly during the course of the next four hours This is all that should ordinarily be given during the day of operation, as a larger volume subjects the patient to the risk of cerebral edema

Conditions in postoperative neurosurgical patients being no different from those in ordinary surgical cases, we have found that the data in our patients during the recovery period agree with those reported by Coller and Maddock[6] In neurosurgical cases, however, the matter of continued fluid replacement requires far greater care than in the ordinary surgical patient, because any excessive ingestion of fluid adds to the ever present risk of cerebral edema The dangers of cerebral edema after brain trauma have been emphasized by Fay,[8] who has also pointed out the importance of a limited fluid intake under these circumstances

Patients with tumor of the brain frequently have been through a period of malnutrition before entering the hospital, so that their serum protein is depleted With a hemorrhage of 1,500 cc at operation they may suffer a further loss of serum protein of 50 Gm Stewart and Rourke,[9] who have studied the effects of comparable acute hemorrhage in dogs, have observed a decrease in serum protein ranging from 0 5 to 1 per cent The consequent reduction in the colloid osmotic pressure of the blood, in conjunction with the presence of an area of traumatized brain tissue where the capillary walls are injured and abnormally permeable, predisposes to cerebral edema If the blood is further diluted by the infusion of excessive amounts of saline solution, edema is especially likely to follow This tendency to edema formation after a reduced protein intake, operation, and infusion has been pointed out by Jones, Eaton, and White[10] and more recently by Mecray, Barden, and Ravdin[11] While the so-called "edema level," with the plasma protein reduced to 5 2 per cent, is not often reached, it should be borne in mind that any reduction of the serum protein means an increased tendency towards the retention of fluid in the interstitial spaces, especially if sodium salts are in-

TABLE IV

PATIENT 29 SUBTOTAL RESECTION OF MENINGIOMA OF WING OF SPHENOID

A Z age 52 —In 1931 the patient noticed swelling in her left temple just behind the eye and also slight protrusion of the eyeball She first entered this hospital in 1933 without any subjective symptoms or neurologic signs Roentgenograms showed the characteristic changes of a meningioma arising from the sphenoid bone On 8/29/33 a subtotal removal was performed by Dr W J Mixter from which the patient made a rapid convalescence

It had been impossible to remove the extension of the tumor into the orbit and as a result the patient noticed increasing exophthalmos She remained free from symptoms, but reentered the hospital in June 1936 with the onset of chemosis of the conjunctiva

A second subtotal removal of the meningioma was carried out by Doctor Mixter 6/23/36 His operative notes are given verbatim

'The old scalp flap was turned down There was very free bleeding The dura was freed up and the wing of the sphenoid was exposed and found to be infiltrated with new growth The dura was opened and the growth was found to be straddling the wing of the sphenoid compressing the temporal and frontal lobes On account of the extensive vascularity of the lesion it was not deemed advisable to remove it in toto Most of the growth back of the sphenoid was scooped out There was very free bleeding from this region, which was partially controlled with muscle packs and the scalp flap was replaced without drainage "

Immediately after the operation there was considerable staining on the dressing, but the patient remained in fair condition and free from shock On the day following operation she lapsed into a semicomatose condition and developed Cheyne-Stokes type of respiration Lumber puncture at this time showed a pressure of 135 Mm and a bloody spinal fluid, on the day before she died the spinal fluid pressure had risen to 300 Mm On the second and third postoperative days she developed deepening coma and a rising temperature which reached 107 5° F at death on the morning of the fourth day after operation No autopsy was permitted

	Weight of Patient without Dressing	Water Drunk	Intravenous	Food Water Including Water of Oxidation	Urine	Specific Gravity	N P N	Stool	Vomitus	Spinal Fluid	Blood	Insensible Loss and Sweating	Maximum Mouth Temperature	Maximum Room Temperature	Total Fluid Intake	Total Fluid Output	Fluid Balance
Day before Operation 8 00 A M 6/21/36 to 8 00 A M 6/22/36	109 970	1 079	0	1 693	722	1 015	29	0	0	0	0	2 275	98 8°	84°	2 773	2,998	225 —
Day of Operation 8 20 A M 6/23/36 to 7 15 A M 6/24/36	109 250	265	1 036*	0 9	664	1 019	25	0	0	0	2 050	1 233	101	70	1 302	3 948	2 646 —
1st Day Postop 7 15 A M 6/24/36 to 7 15 A M 6/25/36	106 604	78	919	51	585	1 019	30	0	81	12	72	2,748	101	70	1 048	3 500	2 452 —
2nd Day Postop 7 15 A M 6/25/36 to 7 15 A M 6/26/36	104 101	0	1 044	28	781	1 024	26	0	0	10	22	2 340	103 5	81	1 072†	3 153	2 080 —
3rd Day Postop 7 15 A M 6/26/36 to 7 15 A M 6/27/36	101 991	0	3 300	91	756		30	0	0	0	23	1 892	107 5	85	3 391	2 671	720+
4th Day Postop 7 15 A M 6/27/36	102 619	Died at 8 57 A M															

The patient s weight and all fluid measurements except blood are recorded in grams Blood lost at operation is given in cubic centimeters

* Includes transfusion of 575 cc

† Intravenous of 3 000 had been ordered, but through an oversight the full amount was not given

fused If the patient has been undernourished and has a serum protein content of under 5 6 per cent, the deficiency should be corrected before operation This can be done easily in the patient who is able to eat by increasing the protein content of the diet Recent work by Field,[12] which is not yet published, has shown that vitamin B, in the form of Lederle's liver extract intramuscularly and Harris's yeast extract by mouth, is of considerable help in raising a low serum protein level In the sick or comatose patient blood transfusions are the only available method of increasing the protein content of the plasma After operation, a patient who remains comatose for a long period must be watched for any significant reduction in the plasma protein When this is discovered, treatment by transfusion or duodenal feeding should be started Unfortunately these patients, even if comatose, are usually too restless and uncontrollable to tolerate nasal feedings Patient 30 illustrates this situation

Case Report—(Patient No 30) F M, male, age 53 A disoriented patient with three months' progression of headaches, nausea, vomiting, loss of vision and memory Examination showed weakness of right face, a marked aphasia predominantly of the receptive type, slight papilledema, and a right homonymous hemianopsia There were no motor weakness or changes in reflexes, but position sense and stereognosis were impaired on his right side Lumbar puncture gave an initial pressure of 250 and a protein of 750 mg

A preoperative diagnosis of left occipito-temporo-parietal glioma was made, and operation performed February 4, 1937, by Doctor White Exploration revealed a deeply situated glioblastoma multiforme in the area predicted A large amount of this was sucked away to form an "internal" decompression, and the bone flap replaced The patient was given a transfusion of 550 cc of citrated blood, after an infusion of 600 cc of 5 per cent glucose in normal saline, and returned to the ward in good condition The blood loss at operation amounted to 753 cc

On the day after operation the patient was in excellent condition and took 1,800 cc of fluid by mouth At this time the report of his preoperative blood chemical analyses was received (Table V) This showed a serum protein of only 5 1 per cent, which was unexpected as he had denied any dietary deficiency His wife subsequently stated that he had eaten no meat for a month and that he had had a very poor appetite during this period During the following days his condition became progressively worse, with uncontrollable restlessness followed by deepening coma His daily fluid intake averaged 1,700 cc of 5 per cent glucose in normal saline by venoclysis Feeding by nasal catheter was impossible because of his lack of cooperation Slight edema of his face and neck were noted on the fourth day, and his serum protein had fallen to 4 7 per cent, after a rise to 5 3 per cent following the transfusion at operation He was therefore transfused again But the swelling of his face and neck continued to increase and on the seventh postoperative day slight edema appeared over his sacrum and ankles At this time his serum protein had risen to 5 4 per cent, his serum sodium was normal, but the chloride elevated to 109 milliequivalents (the first time it had been above normal) The patient was in profound coma with absent pupillary responses and beginning Cheyne-Stokes respiration His spinal fluid pressure had risen to 700 Mm

A diagnosis of cerebral edema was made and the patient reexplored, a week after the first operation On turning down the bone flap the swollen brain bulged under great pressure The bone flap was therefore sacrificed and the scalp resutured A third transfusion was given and a nasal catheter inserted into his stomach In this way it was possible to give increasing feedings rich in protein No further saline was administered On this regimen and after a fourth transfusion, the serum protein rose to 5 7 per cent,

consciousness was rapidly regained, and within five days the patient was able to take a solid diet Coincident with this clinical improvement his subcutaneous edema disappeared

The only other patients who were found to have significantly low serum proteins before operation (5 5 and 5 2 per cent) developed further postoperative reductions to 4 6 and 4 9 per cent (Patients Nos 32 and 35, Table V) Neither gave histories of dietary deficiencies Patient No 32 happens to be one of the seven subjects upon whom complete postoperative fluid balance studies were carried out (Table IV) These statistics give no indication of water retention, as there was a good urinary secretion and a negative fluid balance throughout the period of observation Patient No 35, after a radical resection of a large frontal meningioma, also showed no signs of edema Fortunately in both instances the patients were able to resume a normal diet within a few days Had they become comatose and required intravenous infusions, both might have developed this complication

For the reasons enumerated above the problem of restoring water balance in the neurosurgical patient, who is unable to take solid food or even water by mouth becomes a difficult one The surgeon must estimate the fluid needs of his patient with care, and supply the caloric needs as well as he can Subcutaneous infusions cause unnecessary discomfort, and absorption by proctoclysis is too uncertain Venoclysis, therefore, is frequently the only available method of administering fluids and nourishment to sick postoperative patients

The dependence of water balance on normal quantities of sodium and chloride ions in the blood and tissue fluids has been described by Gamble [13] In contrast to the recovery period after operations on the gastro-intestinal tract, neurosurgical patients rarely vomit more than minimal amounts Yet the data recorded in Table V demonstrate that a moderate reduction in concentration of serum sodium often occurs These patients suffered a loss of base up to ten milliequivalents, while the concentration of chloride ion varied from a slight rise to a fall of nine milliequivalents Such reductions in sodium to 126 and in chloride to 97 milliequivalents correspond to figures obtained in patients after thoracoplasties by Stewart, Talbott, and Churchill [14]

In the absence of vomiting, diarrhea, or wound secretions, these sudden postoperative fluctuations in the concentration of sodium and chloride ions in the blood serum can be accounted for in part by loss through the sweat glands These patients at rest in bed and at room temperatures ranging from 70° to 75° F rarely showed visible sweating, yet it is known that an extensive loss of salt can take place through the skin in other febrile conditions A further explanation for shifts in the concentration of sodium and chloride ions in the blood has been suggested by a recent investigation of Stewart and Rourke[9] on the effects of hemorrhage on the electrolyte balance In their experiments dogs were bled an amount corresponding to the severer grades of hemorrhage encountered in neurosurgical operations As in our postoperative statistics, which are recorded in Table V, they observed that the serum sodium fell distinctly, while variable changes took place in the

TABLE V

CHANGES IN THE BLOOD CHEMISTRY AFTER CRANIOTOMY

	Patient 7 Parietal bone flap and evacuation of subdural hematoma Blood loss 599 cc			*Patient 13* Partial section of fifth cranial root Blood loss 86 cc			*Patient 29* Subtotal resection of meningioma of sphenoid Blood loss 2,050 cc			*Patient 30* Partial resection of glioblastoma multiforme Blood loss 753 cc				*Patient 31* Negative cerebellar exploration Blood loss 927 cc				*Patient 32* Myoplastic subtemporal decompression for oxycephaly Blood loss 487 cc			
	Protein	Sodium	Chloride	Protein	Sodium	Chloride	N P N	Protein	Chloride	N P N	Protein	Sodium	Chloride	N P N	Protein	Sodium	Chloride	N P N	Protein	Sodium	Chloride
Preop	5 7	136	105	5 9		102	29	5 8	102	29	5 1	138	101	20	6 4	137	106	24	5 5	139	105
Postop	6 9		103	5 8	131	101	Transfusion			Transfusion				Transfusion							
1st Day							25	6 1	105												
2nd Day				5 5	136	100	30	5 9	101	26	5 3	138	101			132		17	4 6	138	109
3rd Day	6 6	131	97				26	6 2	109						5 7	132	101		5 5		103
4th Day							30	5 7													
							Died on 4th day			18	4 7	130	105								
6th Day	5 7		100							Transfusion											
7th Day										17	5 4	139	109	17	5 8	138	104	19	5 2	135	106
8th Day										Transfusion											
9th Day	6 1	142	103							28	5 3	136	104	Transfusion							
10th Day										Transfusion											
12th Day	6 0	142	106							29	5 7	128	99								
Comments	Good convalescence			Good convalescence			No solid food postop Coma on 3rd day Total venoclyses of 6,299 Gm 5% glucose in normal saline See Table IV			Onset of coma on 3rd day 6,800 Gm 5% glucose infused in next four days Edematous and moribund on 7th day Recovery after decompression of edematous brain and high protein intake				Good convalescence				Good convalescence Resumed solid diet on 2nd day and developed no edema See Table III			

TABLE V (*Continued*)

	Patient 33 Parietal bone flap and evacuation of subdural hematoma Blood loss 918 cc				*Patient 34* Negative cerebellar exploration Blood loss 708 cc				*Patient 35* Total resection of frontal meningioma Blood loss 1,187 cc				*Patient 36* Frontoparietal exploration and biopsy Blood loss 1,050 cc				*Patient 37* Subtotal resection of frontoparietal astrocytoma Blood loss 1,289 cc			
	N P N	Protein	Sodium	Chloride	N P N	Protein	Sodium	Chloride	N P N	Protein	Sodium	Chloride	N P N	Protein	Sodium	Chloride	N P N	Protein	Sodium	Chloride
Preop	26	7 5	137	101																
Postop						5 9	137	99	19	5 2	138	109	21	5 8	135	98	24	5 6	136	107
1st Day	24	6 3	131	99	Transfusion				Transfusion				Transfusion							
2nd Day					35	5 9	143	103	18	5 5	140	107	37	5 7	138	101	23	5 3	136	101
3rd Day																				
4th Day	19	5 3	133	98	32	5 9	138	100	19	4 9	136	109	33	5 3	140	100	25	5 8	137	98
6th Day																				
7th Day	18	6 2	137	99	32	5 6	136	101		5 0	139	105	36	6 3	126	98	29	5 3	136	111
8th Day	Transfusion																			
9th Day																				
10th Day																				
12th Day															133	99				
Comments	Good convalescence				Good convalescence				Good convalescence Able to resume normal diet on 2nd day and showed no tendency to edema formation				Developed transitory hemiplegia, but made complete recovery The drop in Na and Cl between 3rd and 6th days is due to $MgSO_4$ dehydration and diarrhea				Transitory hemiparesis, but recovered fully			

All determinations were made on blood serum
Analyses are recorded in the following terms
Serum nonprotein nitrogen milligrams per cent, by method of Folin (Laboratory Manual of Biol Chem , D Appleton & Co , 1927)
Serum protein per cent, by modification of method of Folin and Denis (Jour Biol Chem , 26, 473, 1916)
Serum sodium milliequivalents, by method of Butler and Tuthill (Jour Biol Chem , 93, 171, 1931)
Serum chloride milliequivalents, by Van Slyke method, modified by Fiske (personal communication)

chloride level With this they found a sharp increase in urinary potassium Potassium being the principal intracellular base, its increase in the urine must signify that in compensating for blood loss fluid is drawn into the circulation from tissue cells as well as from interstitial areas Since interstitial fluid contains a lower concentration of sodium than plasma and the fluid within the cells contains none, the inflow of fluid from these reservoirs must necessarily reduce plasma sodium On the other hand, the serum chloride level may rise or fall, depending on whether water is withdrawn chiefly from the interstitial spaces, where its concentration is higher than in the plasma, or from the cells themselves, which contain none

Although these chemical changes are not of sufficient magnitude to require replacement in order that the tissues may retain a safe level of hydration, it is important to point out that our lowest values correspond to those found in early Addison's disease Welch, Masson, and Wakefield[15] have reported that a reduction in the blood electrolytes of this degree from an intestinal fistula may be accompanied by symptoms of weakness, drowsiness, and a low blood pressure, but no such symptoms were observed in cases of heat cramps reported by Talbott,[16] where even lower levels were found It has been quite impossible to correlate the postoperative condition of our patients with the level of sodium and chloride ions in the blood serum Patient No 36, for instance, failed to show any symptoms referable to salt depletion when his serum sodium and chloride had fallen to 126 and 98 milliequivalents respectively after a five-day period of magnesium sulphate dehydration and diarrhea (Table V) There is no question that the severe disturbances in blood electrolytes which occur in vomiting and diarrhea must be restored by saline infusions, and it must be remembered that there may be a significant loss of salt from the bowel in magnesium sulphate dehydration But from our present lack of evidence that slight reductions in sodium chloride are harmful per se, any effort to correct symptomless minor deficiencies seems unnecessary

The risk of edema formation inherent in the administration of saline solutions has been pointed out by Coller, Dick, and Maddock[17] These investigators have shown that a reduction in renal secretion and retention of water in the tissues will result when there is an excess of sodium Furthermore, they report that in a group of sick surgical patients given 5 per cent glucose in a physiologic solution of sodium chloride, all retained water and gained weight When the intravenous solution was changed to 5 per cent glucose in distilled water, diuresis took place and the retained water was promptly given up In Patient No 30 (see above), where glucose in normal saline was given by venoclysis over a period of six days, generalized edema developed in the presence of a low serum protein and an elevated chloride (109 milliequivalents) and the patient nearly died of edema of the brain Prior to this dramatic experience and the excellent article by Coller, Dick, and Maddock, we had not been sufficiently aware of the risks inherent in the use of normal salt solution

Edema from too much salt solution is obviously a very real danger For this reason we recommend limiting the routine use of glucose in saline to the

period of operation, during which there is a considerable loss of sodium chloride. Thereafter, fluids can usually be taken by mouth in adequate volume by neurosurgical patients. Saline solutions should only be used when the serum electrolytes are seriously depleted by prolonged vomiting or diarrhea, and then in limited amounts. For a comatose patient 5 per cent glucose in distilled water is the best solution for intravenous use. Glucose so administered is rapidly oxidized and yields 3.75 calories for each gram burned, as well as 0.6 Gm. of water of oxidation. It prevents starvation ketosis and, in addition, the water left is available for renal secretion.

Having described the essential features which govern water exchange in neurosurgical patients, we must now formulate specific rules for the prevention of dehydration and the restoration of an upset water balance once it has taken place. The first requisite is to make sure of the function of the patient's kidneys and his state of hydration before operation. If there has been a period of malnutrition, a low plasma protein must be raised by a diet high in protein and in vitamin B^{12}, or by blood transfusion if operation must be performed at once. Similarly, after a period of vomiting or diarrhea the altered balance in blood electrolytes must be corrected. Regardless of whether there is an excessive depletion of sodium or chloride, the normal equilibrium can be restored by infusions of isotonic salt solution, provided renal function is adequate to handle an excess of either ion. Before operation there is usually no need of limiting fluids by mouth, and it is a good working rule to send no patient to the operating room unless he has passed over a liter of urine on the day preceding the operation.

After operation, every patient who has been put through a major intracranial operation is dehydrated. Our method of giving an intravenous infusion of 5 per cent glucose in normal saline during every extensive operation and one or even more transfusions, whenever an excessive amount of blood has been lost, has been described above. When the patient has been returned to the ward, a chart should be kept of the fluid intake and the output of urine and vomitus, as well as an approximate estimate of the amount of sweating. It has already been pointed out that a comparison of fluid intake with urine output fails to give a complete picture of the water balance, because it neglects the insensible loss of water vaporized from the skin and lungs. In the sick postoperative patient this is usually the largest factor in the fluid loss. In calculating the fluid needs of a patient, it is necessary to make an approximate estimate of the insensible water loss and then to add it to the volume of the urine, vomitus, and feces. It is safe to assume a minimum insensible loss of a liter to 1,500 cc. each 24 hours in a patient with a normal basal metabolic rate who is afebrile and in a room with a temperature below 80° F. (Table III). In very hot weather, or with a fever of over 104° F., the insensible loss may rise to a maximum of over 2.5 liters (Table IV). To maintain a minimum safe urinary secretion (700 to 1,000 cc.) in an adult patient with normal kidneys, the fluid intake must therefore exceed 1.5 liters. Two liters is perhaps a safer minimum daily allowance for patients who do not require a limited intake. Any further reduction in water intake can only be made

with safety if a daily watch is kept to make sure that the specific gravity of the urine does not reach the kidneys' upper limit of concentration* and that there is no hemoconcentration or retention of nitrogen in the blood In the presence of diseased kidneys which are no longer able to excrete a concentrated urine, and also in febrile patients where increased waste materials must be eliminated, a greater fluid intake will be necessary in order to maintain an adequate secretion of urine

In postoperative neurosurgical patients who are able to take adequate fluid by mouth, water balance is easily maintained During the early days of convalescence it is advisable simply to limit fluids to the lowest safe level (1,500 to 2,000 cc daily from all sources in the afebrile patient with normal kidneys) in order to reduce intracranial pressure to a minimum To accomplish this it is necessary to make a rough estimate of the water content of the food eaten (*refer to the figures at beginning of this section*), as well as to chart the liquids drunk, balancing intake from both sources against the large insensible loss of water from the skin and lungs and the necessary excess to supply the fluid needs of the kidneys The figures from such a case are given in Table III

The data in Table IV serve to emphasize the large amounts of blood and fluid which can be lost in the course of an extensive operation for brain tumor, as well as the large volumes of water which can be eliminated during the postoperative course in the presence of a high fever Here the limited ability of the patient to take fluid by mouth had to be supplemented by the intravenous route To have maintained a conservative level of hydration she should have received an intake of over 2,500 cc daily, but through an error a smaller amount was given This protocol is therefore not a fair example of adequate fluid replacement In spite of the low intake, the patient gave no clear-cut evidence of dehydration, aside from a 6 7 per cent reduction in body weight We wish to stress the point that depletion of the interstitial fluid reservoir can proceed to a considerable extent before it can be detected by the clinical appearance or by laboratory tests Characteristic changes cannot be relied on until the blood plasma volume begins to fall and a serious state of dehydration makes its appearance One can therefore safeguard water balance more effectively by appreciating the fluid needs of the patient than by the most careful watch for signs of dehydration Complete postoperative measurements of fluid balance which have been made in five additional cases have shown no essential differences from those recorded above

We realize that we are reducing the margin of safety in recommending such a limited replacement of fluid, which is somewhat more generous than that advocated by Fay[8] for the treatment of traumatic brain injuries, but distinctly lower than that recommended by Coller and Maddock[6] for patients after ordinary surgical operations Granted, however, that the surgeon recognizes this risk and is willing to follow his patient by the quantitative tests

* In the patient with normal kidneys able to concentrate urine to a specific gravity of 1 030, we have felt that readings below 1 025 usually signify an adequate state of hydration

outlined above, we believe that a limited degree of hydration is much safer after operative trauma to the brain than any excess of fluid Blood studies on patients treated in this way have shown no evidence of nitrogen retention, no rise in the erythrocyte count, nor any increase in the hemoglobin, hematocrit, or serum protein indicative of blood concentration

Discussion —The physiology of water balance is of extreme importance to the neurosurgeon because he is faced by the problem of severe dehydration after so many of his operations In addition to the large amount of blood lost in the course of an extensive operation for brain tumor, the loss of water from the skin and lungs is at times greater than during the average abdominal operation, although the loss per hour is distinctly less

For these reasons the patient is nearly always dehydrated during the early recovery period We have, in fact, observed a total fluid loss of 2 5 liters in the operating room In a delirious febrile patient a corresponding amount may be lost daily Without effective replacement such a loss can be tolerated for only a limited period without producing symptoms of severe dehydration Coller and Maddock[7] have shown that this train of events develops when over 6 per cent of the body weight has been lost as water On this basis a patient who weighs 100 pounds (45 5 Kg) cannot afford to lose much over 2 5 liters, nor a 150 pound (68 2 Kg) individual over four liters of body fluid reserve without developing serious complications Mumo[18] has observed semi-comatose patients after severe intracranial injuries who have been treated by intensive dehydration After a prolonged period on an inadequate water intake such cases may develop increasing mental confusion, a rising fever, and a progressive fall in urine volume and spinal fluid pressure to below 50 Mm of water He believes that this syndrome represents a toxic state of dehydration and has given such individuals over 5,000 cc of fluid daily Coincident with the rise in urine output he has observed a striking clinical improvement

While the unfavorable sequelae of dehydration are obvious, the deleterious effects of overhydration are less commonly recognized The general surgeon can safely ensure an adequate intake by allowing a moderate excess, but the neurosurgeon must regulate the fluid balance with much greater accuracy in order to prevent cerebral edema After trauma to the brain, particularly where there is an accompanying reduction in the plasma protein, replacement just short of the normal hydration level is the ideal

SUMMARY

(1) The average neurosurgical patient during the course of an extensive craniotomy loses from 200 to 1,000 cc of water by vaporization from the skin and lungs With a superimposed fluid loss of between 500 and 2,000 cc from hemorrhage, the surgeon is faced with the problem of postoperative dehydration The question of survival or death after a severe operation on the brain often hinges on how effectively water balance is restored

(2) The loss of water vaporized from the skin and lungs can be minimized by

(a) The substitution for ether of local infiltration anesthesia, supplemented if necessary by narcosis with basal avertin or the barbituric acid derivatives

(b) Avoiding the use of too warm coverings in a hot operating room and subsequently in the ward

(3) Replacement of fluid lost at operation is best carried out by the administration of a constant intravenous infusion of 5 per cent glucose in normal saline during the course of all major craniotomies Five hundred to 1,000 cc administered in this way will replace the insensible loss of water which has taken place on the operating table The intravenous apparatus is also available for the transfusion of citrated blood The infusion should be continued in the ward until a total of not over 2,000 cc of fluid has run in In this way the interstitial fluid reserve, as well as the electrolyte balance, can be maintained at slightly reduced but safe levels

(4) Postoperatively, fluid must be replaced much more accurately in neurosurgical than in general surgical patients While the latter may be given a moderate excess of fluid with impunity, a slightly deficient state of hydration is safer in patients after operations on the brain, in order to minimize cerebral edema

(5) In those patients who are able to take fluids by mouth after operation, the problem of restoring the upset water balance is relatively simple But the problem becomes increasingly complex in the sick or comatose patient, where a part or all of the fluid intake must be given by the intravenous route

(6) After neurosurgical operations, a slight reduction in the concentration of sodium and chloride ions may occur, even in the absence of any upset in gastro-intestinal function This reduction in concentration of sodium may reach the level seen in the early stages of Addison's disease, but evidence that it is harmful per se is lacking For this reason it does not seem essential to correct the deficit unless it is aggravated by gastro-intestinal disturbances In the absence of vomiting or diarrhea, 5 per cent glucose in distilled water appears to be a better solution for prolonged intravenous administration than when combined with normal saline because the addition of saline increases the risk of edema

(7) To maintain a postoperative patient in a slightly dehydrated state with safety, the surgeon must have a working knowledge of water exchange It must be appreciated that in addition to the measured output of urine, feces, and vomitus, one to two and one-half liters are lost by vaporization from the skin and lungs in the course of each day If this insensible loss is not taken into consideration, serious dehydration may develop

REFERENCES

[1] White, J C, Whitelaw, G P, Sweet, W H, and Hurwitt, E S Blood Loss in Neurosurgical Operations ANNALS OF SURGERY, 107, 287–297, February, 1938

[2] Rowntree, L G The Water Balance of the Body Physiol Rev, 2, 116, 1922
[3] Underhill, F P Certain Aspects of Water Metabolism Yale Jour Biol and Med, 4, 579, 1932
[4] Newburgh, L H, Wiley, F H, and Lashmet, F H A Method for the Determination of Heat Production over Long Periods of Time Jour Clin Invest, 10, 703, 1931
[5] Coller, F A, and Maddock, W G Dehydration Attendant on Surgical Operations J A M A, 99, 875, 1932
[6] Coller, F A, and Maddock, W G Water Balance in Surgical Conditions Internat Clin, 3, 191, 1934
[7] Coller, F A, and Maddock, W G Water Balance in Surgery J A M A, 108, 1, 1937
[8] Fay, T The Treatment of Acute and Chronic Cases of Cerebral Trauma by Methods of Dehydration ANNALS OF SURGERY, 101, 76, 1935
[9] Stewart, J D, and Rourke, G M Intracellular Fluid Loss in Hemorrhage Jour Clin Invest, 15, 697, 1936
[10] Jones, C M, Eaton, F B, and White, J C Experimental Post-operative Edema Arch Int Med, 53, 649, 1934
[11] Mecray, P M, Barden, R P, and Ravdin, I S Nutritional Edema Surgery, 1, 53, 1937
[12] Field, H, Jr The Relation of Vitamine B to Serum Proteins and to Edema Paper presented before American Society of Clinical Investigation at Atlantic City, May 3, 1937
[13] Gamble, J L Extracellular Fluid and Its Maintenance New England Jour Med, 215, 1150, 1936
[14] Stewart, J D, Talbott, J H, and Churchill, E D Water and Sodium Chloride Balance in Patients Before and After Surgical Operations Jour Clin Invest, 12, 978, 1933
[15] Welch, C S, Masson, J C, and Wakefield, E G Clinical and Laboratory Findings after Excessive Loss of Intestinal Fluid from the Ileum Surg, Gynec, and Obstet, 64, 617, 1937
[16] Talbott, J H Heat Cramps Medicine, 14, 323, 1935
[17] Coller, F A, Dick, V S, and Maddock, W G Maintenance of Normal Water Exchange with Intravenous Fluids J A M A, 107, 1522, 1936
[18] Munro, D The Modern Treatment of Craniocerebral Injuries with Special Reference to the Maximum Permissible Mortality and Morbidity New England Jour Med, 213, 893, 1935

SURGICAL KNOTS*

FREDERIC W TAYLOR, M D

INDIANAPOLIS, IND

FROM THE DEPARTMENT OF SURGERY INDIANAPOLIS CITY HOSPITAL AND DEPARTMENT OF PATHOLOGY, INDIANA UNIVERSITY SCHOOL OF MEDICINE, INDIANAPOLIS, IND

DURING the past few years much interest has been shown in regard to present day sutures This has largely taken the form of studies on catgut and other absorbable materials Meleney[7] as well as Clock[2] have continued their important work on the sterility of catgut and have pointed out the hazards of some of the material now on the market Kraissl[5] has made an interesting study on some of the factors which alter the absorption of catgut Flaws from splicing, foreign bodies and sharp kinks were found to decrease greatly the strength of a given piece of catgut The boilable (anhydrous) type apparently absorbed more rapidly in 2 per cent trypsin than did the non-boilable type Kraissl also demonstrated a rapid dissolution of catgut and disruption of abdominal wounds in guinea-pigs previously sensitized to the catgut This adds weight to the opinions of others [9 1 4] that sensitivity on the part of the patient to catgut is an important factor in the disruption of wounds following premature absorption of the catgut

Other protein suture materials have been suggested and used to some extent abroad These include sutures made of milk casein, muscle tissue, nerve tissue, *etc* It would seem that the undesirable features of a protein foreign body are thus still retained with these, giving no particular advantage over catgut

Jenkins[4] has recently shown that 20 or 40 day catgut maintains its strength but a fraction of this time in the human body It was further shown that plain catgut maintained its strength for four to six days But, when the strength of the catgut depended upon a surgical knot, its strength lasted only two to three days It failed at this early date usually because the knot became untied

Because of the foregoing, briefly outlined disadvantages of catgut suture, there has been a noticeable trend toward nonabsorbable material Recent advocates of the latter include Whipple,[10] Babcock,[1] and Reid, Zinninger and Merrell[8] The strength of wounds sutured with catgut and with silk was studied by Howes[3] who found a greater advantage in the silk

In these discussions on suture failure, one phase is noticeably absent—the least reliable part of any suture—*the knot*

Before starting the present study it was the writer's opinion that the occasional untied knot, seen in experimental work or at the autopsy table, was the result of carelessness It was thought that all carefully tied square or surgeon's knots stayed tied However, at the conclusion of this study

* Aided by Research Division, Indiana University School of Medicine Submitted for publication May 19, 1937

the startling feature seems to be that so many knots stay secure, that there are actually so few failures of abdominal midline, or rectus incisions It is here that the suture knot receives one of its most severe tests

Following the failure of some of our own knots, an attempt was made to review the literature on the subject This was disappointing in that no thorough experimental work could be found The available literature consists, for the most part, of opinions of various writers with no attempt at analysis of the physical factors involved in the knot itself Because of an unsatisfied curiosity the following study was started

It should be stated that this inquiry deals with suture knots which are subjected to constant or intermittent tension It by no means considers as a serious menace those placed about the usual subcutaneous bleeders Here, and in similar sites, any knot which will hold a few hours seems to suffice

Methods.—Animals were first used so that the various knots could be placed under tension in conditions which closely simulated those of the human body It soon became apparent, however, that the conditions in the animal were far too variable The chief difficulty arose in trying to place sutures in identical mechanical, as well as physiologic, situations so as to obtain reliable comparisons The use of animals was abandoned because of these uncontrollable variables Their use was a test of the operator's ability to reproduce identical situations for a large number of sutures and not a true test of the knot itself

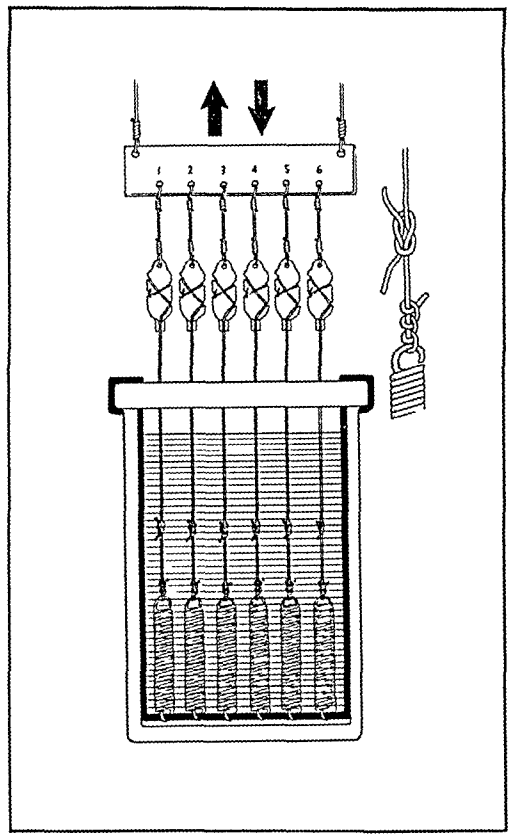


Fig 1.—Knot testing apparatus

The mechanical device shown in Fig 1 was finally decided upon for use in testing the various knots Admittedly, it leaves much to be desired, but nevertheless it gives uniform working conditions The apparatus consists of bronze wire springs fixed at the lower end and attached to the suture to be tested at the upper end The two ends of the suture were tied in a knot a short distance above the spring The ends of the knot were cut to a uniform 5 Mm length and the remaining long end brought up and laced about a fastener This in turn was attached to the cross bar above, which was moved up and down by an electric motor at the rate of 40 times a minute The springs were so adjusted that the upward movement of the cross bar (three-quarters of an inch) produced a two and one-half pound tension on

each suture With the downward motion of the cross bar the suture was completely relaxed

It seemed particularly desirable to test the knots wet as well as dry For this purpose the springs, knots and lower portions of the sutures were immersed in a rectangular glass jar containing the desired solution This could be done without altering the original set-up in any way The solutions used in this phase of the work consisted of water, saline, and 2 per cent trypsin solution

A soft rubber drag was occasionally placed in the jar so as to rub gently against the knots This was done to simulate the rubbing of tissue against knots placed in the body The only effect of this was to cause an early fraying of the suture adjacent to the knot with no tendency to untie it

Knots—The knots used were those of common surgical practice They included the granny, square, surgeon's, and triple throw knots (Figs 2, 3 and 4) A few modifications of these were tried but proved to be of no particular advantage All knots were tied carefully and pulled down hard and firm

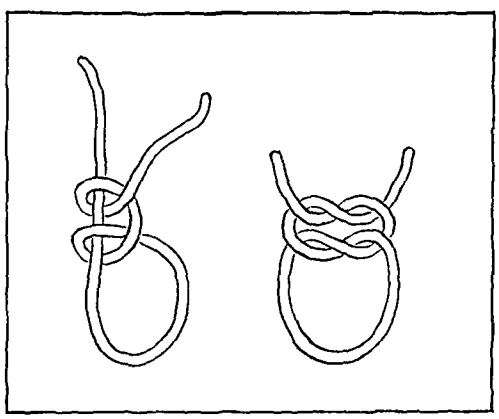


Fig 2—Granny knots Both utterly useless

The sutures consisted of 32 types and sizes of absorbable and non-absorbable material made by 12 different manufacturers No difference was found in comparing the material made by one manufacturer with that of another provided the type of suture was the same However, a great deal of difference was found in the different types of material and whether they were wet or dry A detail that may be frequently neglected by the makers

Results—The test to which all knots were subjected is admittedly a severe one A pull of two and one-half pounds 40 times a minute is not to be duplicated in actual practice However, it was our experience that if the knot pulled out, it practically always pulled out during the first few pulls of the apparatus If it held through these it would hold for hours and finally break in the portion of the suture immediately adjacent to the knot It is evident then that if a suture in the body is subjected to a tension of two and one-half pounds on several occasions, the ability of the knot to hold can be compared directly with the results of the mechanical testing apparatus

(1) Square Knot—(A) *Plain Catgut* When this material was tested *dry the knot held in approximately 85 per cent of the trials, slipped a few* millimeters and held in 10 per cent and pulled out in 5 per cent The square knots which were tested dry and found to hold were then immersed in saline or 2 per cent trypsin solution The machine was again started after a variable period of time (1 to 24 hours) and immediately 80 per cent of

these square knots pulled out This high percentage of failures is partially accounted for by numerous trials using the nonboilable, very pliable and soft catgut We were unable to tie a square knot in this material which would hold if the gut had first been soaked in animal serum or 2 per cent trypsin A reliable knot could be tied dry but not wet The slippery loops of the knot merely rolled over and over to the cut suture ends

(B) *Chromic Catgut* Square knots tied with this material held much better than with the plain gut They held dry in every instance except occasionally in the larger sized sutures which were wiry and could not be pulled down tight When knots known to be solid dry were soaked in saline or 2 per cent trypsin, approximately 25 per cent pulled out when the machine was again started

(C) *Silk and Linen* Knots tied from these materials were the safest

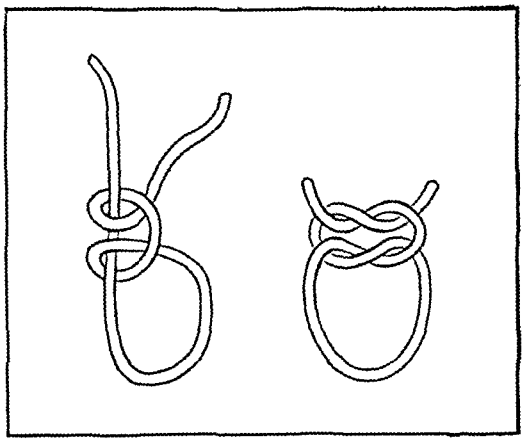


FIG 3.—Both are square knots though the one on the left is quite useless It is produced very frequently by those tying with one hand and keeping slight tension on the suture to keep it taut (Right) Square knot fairly safe with most materials but not safe with the soft pliable type of plain catgut

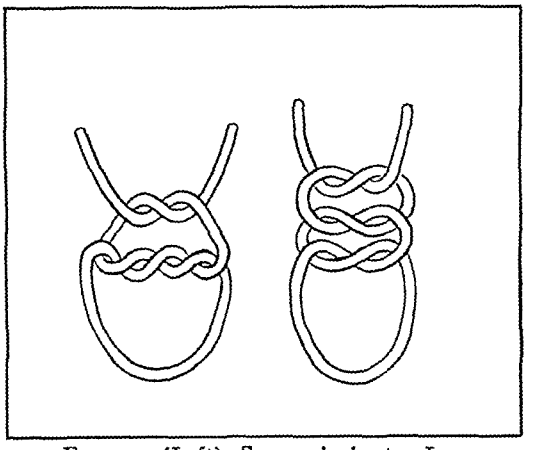


FIG 4.—(Left) Surgeon's knot Less reliable than square knot for catgut ties Unless the second throw causes the first to overlap upon itself, and thus set the knot, it is very apt to loosen and give way (Right) Triple throw knot Safest of all simple knots although it pulls out at times when using wet plain gut and is not safe with the pliable nonboilable type

of any tested They were nearly 100 per cent reliable provided the cut knot ends were left 3 to 5 Mm long

(2) SURGEON'S KNOT.—(A) *Plain Catgut* When tied dry, this knot was very disappointing Its failure was considerably higher than that of the square knot Approximately 35 per cent held, 30 per cent slipped a few millimeters and then held while 35 per cent pulled out immediately on starting the apparatus Of knots holding when tested dry and then soaked in saline or 2 per cent trypsin, 75 per cent pulled out Here again the percentage is unusually high because of including a number of trials with the very pliable nonboilable catgut None of these knots held

(B) *Chromic Catgut* The results were practically the same as with plain (boilable) catgut with many failures of the dry and wet knots

(C) *Silk and Linen* The knots in these materials again were superior to the catgut There were, however, occasional failures

Comment.—It was quite surprising to find the so-called surgeon's knot

so unreliable An analysis showed that the extra loop of the first throw often prevented the second throw from being pulled down firmly on the first When the second throw is pulled back and forth in tightening, it causes the first to overlap in a hard firm knot This will hold, but very few operators take the additional time necessary for this maneuver The knots tied in this part of the test were tied carefully and pulled down hard and tight No attempt was made, however, to work the suture ends back and forth to obtain a harder and more compact knot

(3) Triple Throw Knot (Fig 4) —This knot was by far the most reliable of the three detailed here It was tried with four variations These were triple throw, all throws tied square, first two throws square with third a granny, first throw a granny with second two square, and lastly a triple throw knot with none square (all grannies) Of these variations the triple throw all tied square was the safest The least reliable was the triple throw in which none of the throws was tied square However, this knot was quite as safe as the surgeon's knot or the simple square knot

(A) *Plain Catgut* This held dry in every trial except in a few instances in which the pliable nonboilable variety was tested When the knots were soaked as previously indicated and then again subjected to the intermittent pull of the apparatus, about one-half pulled out As already stated fewer failed in the group with all throws tied square

(B) *Chromic Catgut* This knot and this material were the only combination of aborbable suture which produced a 100 per cent reliable knot under the conditions of the testing apparatus This was true wet or dry

(C) *Silk and Linen* Again 100 per cent reliable

In view of the large number of knots which failed under the conditions listed, a brief analysis would seem in order In the first place a square, surgeon's, or triple throw knot which is reliable can be tied if proper time is taken with tugging on one suture end and then the other until the throws are firmly worked together It must be admitted that this is not the manner in which most surgical ties are made For the most part the throws are pulled together by a hard steady pull This was the case in our test knots, care being taken that the knots were flat and were not allowed to slide on one suture as indicated in Fig 3

As noted, a large proportion of the tested knots which were allowed to soak in saline or trypsin solution immediately pulled out when again subjected to tension But, when such knots were being tested dry and solution added to the jar to moisten them during their intermittent tension, no such failure took place The knots held firmly in 95 per cent of the trials This probably means that as the catgut material becomes softened by the solution it is more tightly pulled into a firmer knot by the constant tension Undoubtedly this same process must take place in conditions of actual use, or there would be far more wound failures On the other hand when the catgut knot absorbs moisture and is without tension, the swelling

of its fibers loosens the knot leaving it quite vulnerable to any subsequent tension

The size of the suture material played a part in the stability of the knots In heavy wiry material such as No 2 chromic, the knot would often not stay tight but would again spring open Once the knot was made to stay tight and compact there seemed to be little difference between the large and small sizes using the uniform tension of two and one-half pounds

Knot ends were cut to a length of 5 to 6 Mm for gut sutures and 3 to 4 Mm for nonabsorbable sutures Shorter ends than this gave knots which were not at all reliable

Several points were quite puzzling Why should silk and linen knots

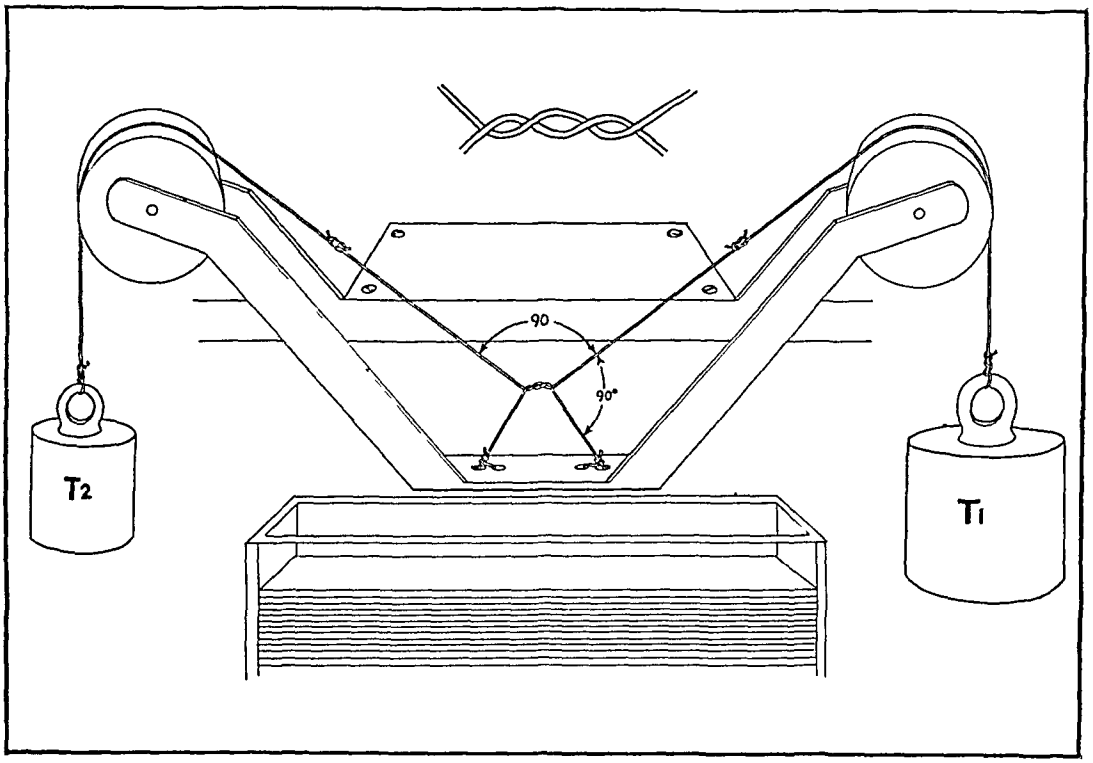


FIG 5 —Apparatus used in determining coefficient of friction of various suture materials When this was to be determined on wet sutures, the jar beneath was elevated so as to immerse the two strands being tested

hold so much better than those of gut? Also why should chromic catgut give safer knots than plain? Why should the pliable nonboilable plain gut give knots which are entirely unsafe unless triple or quadruple throws are used?

Coefficient of Friction —In the final analysis a knot in string or thread stays tied because of friction of one portion of the knot upon another If the coefficient of friction of the particular material is great, the knot will hold firmly If the coefficient of friction is very small, then the component parts of the knot will slide upon each other, and the knot will fail

It was thought, therefore, that this was the deciding factor The reason plain catgut knots failed so frequently when they were wet was that as the catgut became wet it also became slippery, and hence possessed a much

lowered coefficient of friction While this thesis is true of nonabsorbable materials such as silk and linen, the coefficient of friction proved not to be the all important factor in catgut

It seemed desirable then to learn the coefficient of friction of various suture materials both in the dry and wet state Through the aid of A A Potter, Dean of Engineering, Purdue University, it was learned that no standard method exists for determining the coefficient of friction of silk thread against silk thread, catgut against catgut, *etc* Furthermore, Dean Potter could learn of no available data indicating the coefficient of friction of thread against thread when placed in the form of a knot

With no precedent to follow we felt free to design an apparatus which would best meet the demands of our particular problem The result was the apparatus illustrated in Fig 5 Here one strand of the suture to be tested was fastened to the base A second strand interlaced around the first thus forming an angle of contact of 540 degrees In most of the tests only a single loop was made (180 degrees) since the longer contact had a tendency to override and give false friction values This was particularly true of the finer sutures The length of the first (lower) suture was adjusted so that the two formed 90 degree angles as indicated The free ends of the second suture were fastened to weights over freely moving ball bearing pulleys Weight T_2 was a constant being in the various trials 50, 100, 150, and 200 Gm Weight T_1 was then increased to a point where the second suture was about to slip through the overlapped first suture The greatest weight which could be added without slipping was taken as T_1

With these available figures the coefficient of friction was calculated by direct substitution in the formula used for computing belt and pulley friction[6]—

$$\frac{T_1}{T_2} = e^{fb} \quad \text{or} \quad \log_{10}\frac{T_1}{T_2} = .4343\ fb$$

In the above, T_1 and T_2 were determined experimentally, $e = 2.718$ (base of the Napierian system of logarithms), f = coefficient of friction, b = angle of suture contact in radians All these factors are known with the exception of f (coefficient of friction) Therefore, f can be determined by substituting the values obtained for each trial run For the sake of brevity no mathematical discussion or example computations on trial runs will be given The average results of these trials are indicated graphically in Fig 6

As has been previously indicated and known to all surgeons, suture knots which are wet behave far differently than when dry A silk suture knot apparently holds much better when wet while plain catgut which has been allowed to soak in serum is extremely hard to tie so as to be secure It, therefore, was important to determine the coefficient of friction values for the various sutures after they had been soaked in serum as well as their values dry Wet suture tests were made while the sutures were still immersed

in serum in a flat glass container which was elevated into place The results are also shown for comparison in Fig 6

A comparison of these average wet and dry values is quite interesting It will be noted that silkworm gut, dermal and the strong hard twist type of silk showed no increase in friction value after they had been soaked in serum On the other hand, the coefficient of friction on linen and standard surgical silk increased approximately two and three times when wet with serum This is rather important since it indicates that knots tied with these materials are more apt to stay tied than those with lesser frictional values However, it also indicates another factor which tends to prevent a safe knot When a knot is tied with linen or standard surgical silk the material is always wet or at least damp with serum This means that it has an unusually high coefficient of friction which in itself may prevent pulling the throws tightly together without breaking the suture Such an experience is known to all operators and is particularly common in trying to pull down snugly the first throw of a surgeon's knot The suture often breaks, and the operating room personnel receives a vindictive blast for having boiled the silk too long

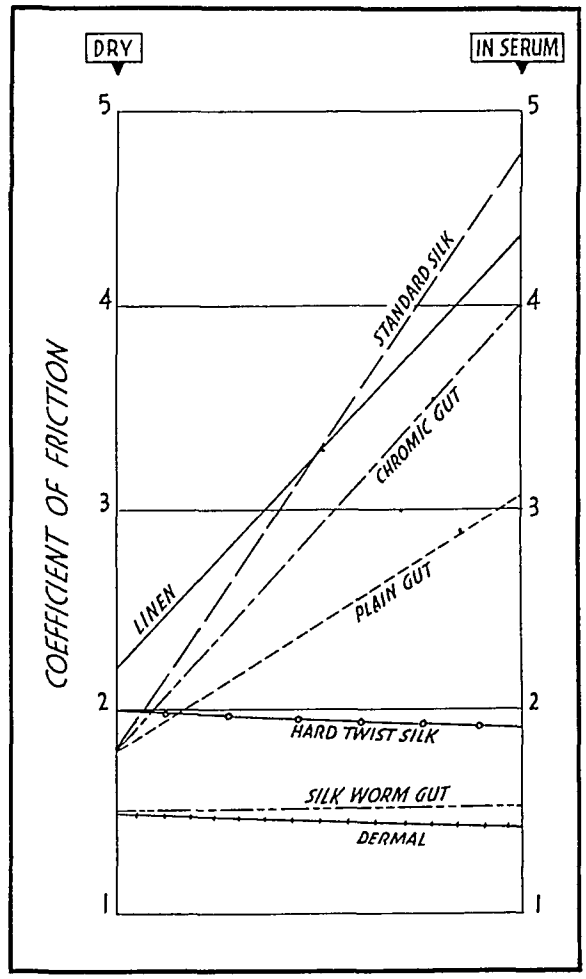


Fig 6—Coefficients of friction for various suture materials when in the form of a knot On the left are shown values for the dry suture On the right are the values for the same sutures after they have been soaked for a short time in serum The lines between the two values merely represent graphically the degree of change

The dry and wet coefficient of friction values for catgut were quite surprising This was particularly true in the case of plain catgut It was expected that this material would show a lower friction value wet than dry since grossly it seems to become more slippery and since knots pull out so much more readily wet than dry This was not found to be the case There was an approximate 80 per cent increase in the friction values on plain catgut as indicated in Fig 6 The values for chromic catgut more than doubled when saturated with serum This latter fact coincides with our knot experiments and that of clinical experience to explain the more reliable knots obtained with chromic catgut

It should be stated that by the described method of testing for coefficient

of friction, the smaller sizes of suture material gave slightly lower values than the larger sizes The differences were not great and have been omitted from the discussion and Fig 6

Suture Elasticity—It is obvious that an adequate explanation has not been given for the more frequent failure and slipping of plain catgut suture over other materials Especially is this true with the wet gut, for though the frictional values are greater than when dry, the simple knot is practically useless in the wet state

There is another factor peculiar to catgut as compared with nonabsorbable materials which very definitely affects the safety of a knot This is the resilience or elasticity of the material It is well known that catgut swells and is considerably more elastic when wet than when dry

It was found that a full length strand of number one plain catgut stretched from 1 to 1 5 per cent when subjected to 1 Kg tension Identical figures were obtained for similar chromic material But, when these two sutures were again tested after soaking for a short time in saline, quite a change was noted The plain gut had an average elasticity (stretch) of 15 per cent while that of the chromic was less than 7 per cent This is contrasted with the values obtained for linen under similar conditions These were 0 7 per cent stretch dry and 1 8 per cent wet

The significance of the foregoing is apparent by comparison with other elastic materials For instance, the tied ends of a rubber band readily slip out of their knot when subjected to any degree of tension The knot does not become untied, its loops merely roll over and over each other until the knot ends are reached So it is with catgut and particularly the pliable type of plain catgut

One more factor seems worthy of note in regard to the slipping of catgut knots Catgut swells and increases in size when allowed to soak in serum or saline It was found that the diameter of boilable No 1 plain gut increased on an average of 55 per cent This value was somewhat lower for nonboilable and chromic catgut It seems likely then that a knot tied with dry material may actually "swell itself loose" This is undoubtedly more of a factor with the larger sized strands

Discussion—Again it should be stated that this inquiry into the safety of knots and suture materials applies only to those which receive definite tension Those used for the ligation of subcutaneous bleeders or for closing the skin do not enter into the discussion

The high proportion of knot failures cited is in part due to the severe test to which they were subjected It seems probable, however, that in any abdominal wound, several of the sutures and their knots may be subjected to a tension of two and one-half pounds To these our results are directly applicable No study was made of knot failure using tensions less than the above

The experimental work on the cause of frequent knot failure in catgut

is principally of academic interest It explains at least some of the causes for failure of plain catgut knots as compared with other materials

It is believed that many of the suture failures which are seen clinically are due actually to the knot becoming untied rather than breaking or premature digestion of the catgut

SUMMARY

(1) Many suture failures are due to the knot rather than the suture material An inquiry is here recorded on the reliability of common surgical knots

(2) It includes only those knots and their sutures which are subjected to an appreciable tension

(3) The tests to which the knots were subjected are admittedly strenuous They are, however, quite within the realm of general clinical experience

(4) Any conclusions must be tempered by the realization that there exists a wide variation in different operators' knots and in different knots of the same operator

(5) Notwithstanding these variations some broad generalizations may be stated

(6) Safest of all common surgical knots is the triple throw knot (Fig 4) This is safest when all throws are tied square but is also quite reliable if any two of the three throws are tied square

(7) The square knot is more reliable than the surgeon's knot The latter is difficult to pull down tight enough so that it will not slip out

(8) The least reliable knot material is plain catgut, particularly the pliable, nonboilable type This is seldom safe in square or surgeon's knots and occasionally fails in the triple throw knot

(9) From the standpoint of the knot, chromic catgut is much safer than plain though only in the triple throw knot does it approach 100 per cent reliability

(10) A marked difference is noted in the holding power of catgut knots in the dry and in the wet states A knot which is perfectly safe when dry may readily slip out when moistened with serum

(11) An inquiry was made into the causes of failures in the catgut knots wet with serum Contrary to common belief, wet catgut is not more slippery than dry In fact the frictional value increases when this material is soaked in serum (Fig 6) It is contended that this failure is largely due to the marked increase in elasticity of the catgut (particularly plain) when wet with saline or serum An apparatus for testing the coefficient of friction of materials tied in the form of a knot is described Another factor in the failure of catgut knots is the swelling of the material itself when moistened (approximately 50 per cent) This, undoubtedly, has a tendency to loosen the throws of the knot

(12) Knots made in linen or silk sutures are much safer than those of catgut The wetting of these with serum has no tendency to cause them to

slip Again the surgeon's knot was less reliable than the triple throw or square knot The two last named approach 100 percent reliability when using linen or silk

(13) Cutting the suture ends shorter than 5 Mm for catgut and 3 Mm for linen or silk is a distinct hazard to the knot

(14) Knots tied in large sized material occasionally fail because the suture is too bulky or wiry to be pulled down snugly

(15) If the knot holds, the next weakest point is immediately adjacent to it, where the suture fibers have been fractured in the tying

REFERENCES

[1] Babcock, W W Catgut Allergy Am Jour Surg, 27, 67, 1935
[2] Clock, R O A Reliable Method for Testing the Sterility of Surgical Catgut Sutures Surg, Gynec, and Obst, 61, 789, 1935
[3] Howes, E L Strength of Wounds Sutured with Catgut and Silk Surg, Gynec, and Obst, 57, 309, 1933
[4] Jenkins, H P Personal Communication and a Clinical Study of Catgut in Relation to Abdominal Wound Disruption Surg, Gynec, and Obst, 64, 648, 1937
[5] Kraissl, C J Intrinsic Factors Altering the Absorption of Catgut Surg, Gynec, and Obst, 63, 561, 1936
[6] Mechanical Engineers Handbook, L S Marks, editor, First Edition, 248, 1917, McGraw Hill, New York
[7] Meleney, F L Infection in Clean Operative Wounds Surg, Gynec, and Obst, 60, 264, 1935
[8] Reid, M R, Zinninger, M M, and Merrell, P Closure of the Abdomen with Through-and-through Silver Wire Sutures ANNALS OF SURGERY, 98, 890, 1933
[9] Smith, J, Jr Preparation of Catgut for Surgical Use Australia and New Zealand Jour Surg, 4, 122, 1934
[10] Whipple, A O The Use of Silk in the Repair of Clean Wounds ANNALS OF SURGERY, 98, 662, 1933

BRIEF COMMUNICATIONS AND CASE REPORTS

INTRAPERITONEAL STREPTOCOCCIC ABSCESS COMPLICATING ACUTE PHARYNGITIS[1]

ACUTE ILEUS OPERATION RECOVERY

ARTHUR S W TOUROFF, M D
NEW YORK

Case Report—M S, female, married, age 38, was admitted to the Mount Sinai Hospital at midnight, April 10, 1934, with a history of having developed an acute pharyngitis, characterized by sore throat and mild fever, four days previously Symptoms continued for three days, at which time the temperature became higher and she began to suffer dull abdominal pain This was most marked in the lower half of the abdomen and was not accompanied by nausea or vomiting Within several hours, the pain became severe and cramp-like, and temperature rose to 105° F The past history was essentially negative except for an induced abortion five years previously There had been two other pregnancies, both children living and well The venereal history was negative

Physical Examination—The patient appeared acutely ill Temperature 105° F, pulse 136, respirations 28 The pharynx and tonsils were deeply congested A purulent, postnasal drip was present The abdomen was slightly distended, tender, and moderately rigid throughout, the physical signs being most marked in the right lower quadrant No masses were palpable On pelvic examination, the cervix was tender There was no vaginal discharge In the right adnexal region, a slightly tender mass about four inches in diameter was palpable On the left side, a similar but smaller mass was present

Laboratory Data—White blood cells 33,000, polymorphonuclear leukocytes 92 per cent, of which 66 were segmented and 26 were nonsegmented Lymphocytes 8 per cent, red blood cells 4,850,000, hemoglobin 90 per cent, sedimentation rate 20 minutes Blood pressure 86/60 Urine acid, specific gravity 1,022, trace of albumin, occasional white blood cells and hyalin cast Weight 130 pounds

The first impression was that of a patient suffering from acute, bilateral, adnexal inflammatory disease with secondary lower abdominal peritonitis, but that, in view of the preceding history of an acute pharyngitis, the diagnosis of pneumococcus or streptococcus peritonitis was to be strongly considered In view of the positive pelvic findings, the patient was admitted to the gynecologic service

The patient was immediately placed upon a continuous intravenous infusion of 5 per cent glucose, and the routine treatment of pelvic peritonitis During the first week the temperature ranged between 101° and 106° F By the end of the second week, the temperature gradually assumed a lower level and began to range between 100° and 102 6° F In the meantime the blood culture, taken at the time of admission, was reported negative, and the throat infection had subsided completely The diffuse abdominal signs gradually receded, but tenderness and slight spasm still remained in the right lower quadrant Meanwhile, a firm pelvic exudate developed behind the cervix Over a period of five weeks, the temperature continued between 100° and 102 6° F By this time the pelvic exudate increased in size and now extended completely across the pelvis from one

[1] Presented before the New York Surgical Society, October 13, 1938 Submitted for publication December 29, 1937

side to the other There was, however, not sufficient evidence of softening at any time to warrant surgical drainage Because of a gradually falling hemoglobin, which finally reached 60 per cent, a transfusion of 500 cc of citrated blood was given At the end of the seventh week of illness, the temperature again became septic in type and began to range between 99° and 104° F At that time, increasing abdominal distention appeared and the patient began to vomit This at first was only occasional, but it became more frequent and finally necessitated the use of an indwelling Levin tube and the administration of fluids intravenously Abdominal distention became marked, and enemata now were only partially effectual Examination of the abdomen revealed the presence of an intra-abdominal fluid wave which, during the course of a week, became marked At that time (eight weeks after admission) surgical consultation was requested When seen by the surgical service the patient presented an unusual clinical picture She was markedly emaciated and had a large, tense, protuberant, diffusely tender abdomen, within which a fluid wave could be readily elicited The indwelling Levin tube was draining large amounts of upper intestinal secretion On pelvic examination, no definite pelvic exudate was palpable, there being only an indefinite sense of resistance and tenseness throughout Temperature was 104° F , pulse 124, respirations 36 From the history and physical examination it appeared that the patient was suffering from a diffuse, low grade, purulent peritonitis associated with a large amount of intraperitoneal pus and a complicating ileus Abdominal puncture was performed and a syringeful of thick, greenish-yellow, odorless pus was aspirated, a smear of which showed gram-positive cocci in chains, which were later identified as hemolytic streptococci

Operation—June 13, 1934 Under local anesthesia, a one and one-half inch McBurney incision was made and the peritoneum exposed Aspiration disclosed pus at once The opening was enlarged, and 5,100 cc of pus evacuated The previously protuberant abdomen became scaphoid A long curved instrument, passed into the wound, extended across the abdomen into the left lower quadrant and well upward toward the diaphragm The finger appreciated a large smooth-walled cavity, the limits of which could not be determined No intestines were visible, and it was apparent that the latter had been pushed posteriorly, and lay behind a pyogenic membrane which formed the posterior limit of the cavity The condition was, therefore, a huge intraperitoneal abscess lying in the anterior portion of the abdomen Because of the patient's poor general condition more complete exploration was not attempted No counterdrainage was introduced, the thought being to tide the patient over the critical period and to establish more thorough drainage at a later date An open end, large caliber, mushroom catheter was introduced into the abscess cavity and the superficial wound packed with iodoform gauze

There was practically no postoperative reaction, and within three days the temperature fell below 100° F The symptoms of ileus subsided almost at once Purulent drainage through the tube diminished from 20 ounces on the first postoperative day to two ounces on the fifth day Eight days after operation, roentgenologic examination of the abdomen was made after the injection of lipiodol into the cavity through the wound, in order, if possible, to determine the limits of the cavity and the best sites to introduce counter-drains The films revealed the lipiodol extending irregularly from the right to the left limits of the abdomen and from the pelvis upward to the region of the diaphragm Because of its large size no attempt was made to fill the cavity completely

Second Operation—On June 26, 1934, 13 days after the original operation, under avertin-gas-oxygen anesthesia, three counterincisions, one in the right lower quadrant, another in the left lower quadrant, and a third in the left upper quadrant, were made At this time the interior of the cavity was explored more completely, and the limits found to correspond with those demonstrated by previous roentgenologic examination The intra-abdominal viscera were all found displaced posteriorly and could not be identified owing to their being covered by a pyogenic membrane which formed the posterior wall of the cavity Approximately at the level of the umbilicus, there was a small defect in the membrane, through which several matted knuckles of intestine were visible The wounds were packed with gauze

Following operation the patient reacted slowly, apparently due to an overdose of avertin, although the amount given was presumably within safe limits Within 24 hours she had recovered completely from this episode, but then developed a toxic-exhaustion psychosis, which continued for about a week but responded promptly to a transfusion From that time on, her course was entirely satisfactory About two months later one of the small knuckles of bowel, which was noted at operation, perforated, apparently as the result of pressure of a small tube drain A small amount of fecal discharge continued for one week when the fistula closed spontaneously

The patient was discharged from the hospital on the eighty-fourth day following the second operation, at which time, two small granulating wounds and a residual cavity, with a capacity of two ounces were present Her weight was 104 pounds, a gain of 29 pounds from her recorded low of 75 After leaving the hospital, her wounds were dressed in the Out-Patient Department, from which she was discharged completely well after six weeks She has been followed in the Return Clinic for three and one-half years, to date, during which she has remained entirely asymptomatic Her present weight is 135 pounds

Discussion —The above case is of interest for several reasons First, it illustrates an unusual cause of acute ileus At the time of operation, ileus, while not complete, appeared to be rapidly becoming so Whether the ileus was of the so-called dynamic or adynamic type cannot be stated, but from the nature of the intraperitoneal lesion it may well have been either Secondly, the case is of interest because it illustrates an unusual lesion While streptococcic peritonitis following upper respiratory infection is not uncommon in children, it is rare in adults Super-added, there was the development of an unusual lesion namely, a massive intraperitoneal abscess which filled the entire anterior portion of the abdomen Finally, the case illustrates the value of diagnostic abdominal aspiration as described by Drs Harold Neuhof and Ira Cohen some years ago If this procedure had been performed at the time of the patient's admission to the hospital, the diagnosis of streptococcic peritonitis would have been made immediately

Discussion Dr Harold Neuhof (New York) referred to a roentgenogram of the chest of the case cited which presented a very interesting feature, which might possibly throw some light on the process of the evolution of this interesting abdominal lesion The patient's condition began with an upper respiratory infection (acute pharyngitis) During her hospitalization a pneumonic process in the right lower lobe with some pleural exudate was demonstrated Subsequently this bronchopleural process subsided, but it seems that in this, as in a few other similar cases which he could recall, there is a possibility that the pathway of infection was from the mediastinum into the posterior retroperitoneal spaces Thus the intraperitoneal exudate would be a by-product of the retroperitoneal pathologic progress Doctor Touroff exercised sound judgment in not exploring widely in order to determine just to what extent the peritoneal cavity was invaded

With regard to the possibility of diagnosing cases of this kind at a much earlier stage of the intraperitoneal process than was done in the present instance, Doctor Neuhof advocated the use of abdominal puncture for the diagnosis of certain cases of acute intraperitoneal infection If the case cited had had an abdominal puncture performed at an early stage, it is possible that the process would have been recognized and the patient subjected to operation considerably earlier than she was In many cases the nature of the infection

can be definitely established in this way, and certainly the question of whether or not to proceed with operation can often be determined

DR SIGMUND MAGE (New York) cited the case of a white woman, age 31, who was originally seen five weeks after the onset of her illness She had been first treated at the Morrisania Hospital where she had been admitted five days after the onset of an upper respiratory infection associated with upper abdominal cramps and diarrhea The impression then was that the patient was suffering from pneumonia associated with general peritonitis On this basis, she was treated in an oxygen tent for three days, following which her respiratory affection apparently cleared up The abdominal distress, cramps and signs of abdominal fluid, however, persisted She was transferred to Doctor Neuhof's service at Mt Sinai Hospital approximately four weeks after her admission to Morrisania Hospital She then presented a picture of an acutely ill patient Temperature was 102° F, white blood cells 26,000, 80 per cent polys The abdomen was markedly distended, and there were present signs of fluid The impression was of a patient suffering from a tuberculous peritonitis An abdominal puncture was performed and a thick, creamy pus was obtained, which on smear revealed extracellular gram-negative diplococci Under local anesthesia, a small McBurney incision released six liters of thick, creamy pus Doctor Mage's impression was that he was dealing with a large abscess cavity with the gut compacted posteriorly into as small a space as possible A small counter incision was made on the left side A tube introduced passed through both incisions, 200 cc drained during the first 48 hours Recovery was uneventful and the patient was discharged six weeks after admission When seen six months ago she was in excellent health The culture proved to be a pneumococcus Type I

RUPTURE OF INTESTINE INTO ABDOMINAL SCAR *

SIGMUND MAGE, M D
NEW YORK

Case Report—The patient, a white male, age 35, was first admitted to the Beekman Street Hospital May 7, 1936, with a six hour history of severe right upper abdominal colic associated with several vomiting attacks The findings were those of an acute cholecystitis associated with an acute respiratory infection The symptoms progressed rapidly so that within 24 hours exploration was deemed imperative, and a cholecystectomy with drainage was performed for a completely gangrenous gallbladder The patient's immediate postoperative course was relatively smooth except for a persistent cough

On the ninth postoperative day some separation of the skin was noted at the upper end of the wound just below the site of the drainage tract

On the twelfth postoperative day the skin separation had extended for at least one-third of the extent of the incision, and a granulating area was seen in its depths which suggested intestine The condition was considered a partial dehiscence without a prolapse of intestine or compromise of its function

By June 5, 1936—28 days after operation—the patient was discharged with the wound healed except for a superficial separation of the skin edges He attended the Out-patient Department twice a week for a month, at the end of which time complete healing had taken place, and he was able to return to work

On August 8, 1936—74 days after his discharge from the hospital—he was readmitted,

* Presented before the New York Surgical Society, February 24, 1937 Submitted for publication May 2, 1937

stating that While helping in the lifting of a heavy ladder he suddenly became aware of a moistness on his abdomen and discovered a profuse drainage coming from an opening in the abdominal scar While there was a consciousness of a straining effort, there was no particular pain accompanying the experience He returned immediately to the hospital where examination revealed a thin biliary-like discharge containing some food particles coming from the old drainage tract Methylene blue given by mouth appeared in 45 minutes through this site and established the presence of an intestinal communication Despite the immediate application of a protective coating of bronze paste, the drainage caused a progressive digestion of the skin which, within a few days, involved most of the upper abdominal wall

This was finally controlled by introducing a continuous drip of one-tenth normal hydrochloric acid into the fistulous opening and plugging it by gauze soaked in bovinine This was started one week after the patient's admission, and the healing of the skin progressed rapidly except for an area of painful irritation immediately about the fistulous opening The patient had a striking mental reaction to this discomfort, becoming uncooperative and threatening suicide unless relieved This prevented any further delay for better skin healing and, on September 15 1936—27 days after his second admission—he was operated upon There was an obvious ventral hernia, but because of the condition of the abdominal wall, it was felt wise to limit the procedure to the intestinal problem

Operation—A nine inch segment of small intestine—apparently lower ileum—with a 2½×5 cm defect in its antimesenteric aspect was found to be firmly fixed in a hiatus in the abdominal wall musculature Upon releasing this loop, it was evident that the intestinal rupture could not be closed without compromising its lumen A segment six inches long involving the defect was, therefore, resected and continuity of the intestinal tract reestablished by a side-to-side anastomosis The abdominal wall was closed by through-and-through heavy silk sutures without attempting to correct the ventral weakness

The patient's postoperative course was uneventful except for some separation of the wound which healed without any complication He was discharged October 13, 1936—28 days after operation He has remained well but has a large ventral hernia which is to be repaired at some future date

This case is of interest because an intestinal rupture through an abdominal scar is apparently a very unusual complication A cursory search of the English literature for the past ten years has revealed no similar cases The mechanism, of course, is apparent namely, a muscular strain tearing the wall of a fixed, prolapsed loop of intestine which had most probably been weakened by previous infection It is surprising, with the high incidence of recognized and unrecognized wound dehiscences and the large number of postoperative herniae, that this type of complication is not seen more often

SPONTANEOUS RUPTURE OF THE LIVER IN MALARIA

CASE REPORT

JOHN S McEWAN, M D , AND DUNCAN McEWAN, M D
ORLANDO, FLA

RUPTURE of the liver often presents itself to us in traumatic cases and occasionally we may see or read of a case of spontaneous rupture of the liver The spontaneous rupture is usually the result of syphilis, either hereditary

Submitted for publication June 28, 1937

or acquired, of carcinoma, either primary or metastatic It has rarely been reported in other conditions

E Devic and L Beriel,[1] in 1906, reviewed the literature and collected several cases of spontaneous rupture The apparent causes of these varied One occurred from obstruction due to gallstones, one was reported in a patient with pleurisy and pericarditis, where the liver was said to have been very friable as the result of high temperature, another occurred on the twenty-ninth day of convalescence from typhoid fever, others were due to either carcinoma or syphilis Nauwerck[2] reported a case due to bile stasis from stone obstruction, Walz,[3] in 1921, records a case due to multiple aneurysms of the liver, and Mast,[4] in 1933, had a case resulting from primary carcinoma of the liver

Maze[5] gives perhaps the most logical explanation of the pathology of this condition "In traumatic rupture, the rupture is the cause of the hemorrhage In spontaneous rupture, the hemorrhage is the cause of the rupture The chain of events leading to rupture are infarct, hypervascularization at the periphery, rupture of a vessel, intrahepatic hemorrhage, with resulting rupture of the tissues and production of a subcapsular hematoma, which when rupturing the capsule permits escape of blood into the peritoneum leading to peritonitis and death"

We have been unable to find any reports of spontaneous rupture of the liver resulting from malaria

Case Report—H B, female, age eight, was admitted to the Orange General Hospital at 10 A M, March 3, 1931, complaining of severe abdominal pain Two weeks before admission, she had been seized with a sudden sharp pain in the left upper abdominal quadrant, which radiated to the right lower quadrant This was accompanied by a slight fever, but there were no other accompanying symptoms The following day the pain had decreased in intensity, but was still present in the left upper quadrant A diagnosis of tertian malaria was made, after a positive blood smear

Following the administration of quinine the patient developed pain in the right upper quadrant, just beneath the costal margin in the gallbladder region The pain was constant, but was worse on alternate days, becoming progressively more severe, and was accompanied every other day by a temperature of 100° to 101° F She had no chills at any time Two weeks after the onset of her illness, March 2, 1931, the patient experienced a very acute pain on the right side of the abdomen, broke out in a cold sweat, and had to sit up rather than lie down That evening the pain became less, but she could not sleep The following morning, however, the pain had become more severe and she was brought to the hospital

Her past history was essentially negative except that she had always been thin and frail Since a tonsillectomy six months previously, however, she had been gaining weight and feeling better There was no history of trauma or injury He family history was negative and the parents showed a negative blood Kahn reaction

Physical Examination showed a patient, apparently in a critical condition, who appeared pale, restless and anxious Her examination was essentially negative except for the local abdominal condition The abdomen was distended and slightly rigid, the rigidity being more marked over the right side There was tenderness over McBurney's point and also just beneath the right costal margin, but rigidity precluded the palpation of any masses The spleen was markedly enlarged and tender The temperature on admission was 103° F, pulse 136, respirations 40 Leukocyte count 13,800, with 85 per cent poly-

nuclear, 9 per cent small and 6 per cent large lymphocytes A smear did not show any malarial parasites at this time The urine was acid, specific gravity 1,019, clear, one plus albumen and an occasional pus cell A tentative diagnosis of a ruptured appendix was made

Operation—Under nitrous oxide and oxygen anesthesia plus local novocain infiltration, the abdomen was opened through a right rectus incision, and a quantity of dark red blood was encountered The appendix was normal On extending the incision upward, a clot was exposed extruding from a rupture of the right lobe of the liver, near the inferior margin and the anterior surface The liver was greatly enlarged, as was the spleen The clot was removed and a rent in the liver approximately 2×2½×½ inches was revealed The tissue seemed broken down This cavity was cleaned out and packed with gauze and the abdomen closed The patient left the table in very poor condition and in spite of supportive measures, expired 15 hours later Permission for necropsy was not obtained

COMMENT AND SUMMARY—The case is of interest because there have been no instances reported of spontaneous rupture of the liver in malaria The history of intermittent fever, the finding of tertian malaria plasmodia in the blood, and the enlarged spleen and liver present the malaria picture Undoubtedly focal necrosis took place in the liver substance, resulting in hemorrhage, distention of the capsule and subsequent rupture This but adds another complication of malaria, and another cause for an "acute abdomen"

REFERENCES

1 Devic, E, and Beriel L L'apoplexie hepatique dans la syphilis, considerations sur les ruptures spontanees du foie Ann de dermat et syph, 7, 642–665, 1906
2 Nauwerck Ruptur der Leber durch Gallenstaung Munchen med Wchnschr, 52, 931–932, 1905
3 Walz Ueber multiple Aneurysmen der Leberarterien mit Leberruptur Verhandl d deutschen path Gesellsch, 18, 142–143, 1921
4 Mast, W H, and Streamer, A W Primary Carcinoma of the Liver with Spontaneous Rupture, J A M A, 100, 1684, May 27, 1933
5 Mazel, M Aupropos des ruptures spontanees du foie Rev de medecine legale, 20, 238–239, 1914

INJURY OF THE LIVER

REPORT OF TWO CASES

CHARLES D BRANCH, M D
PEORIA, ILLINOIS
FROM THE SURGICAL CLINIC OF THE PETER BENT BRIGHAM HOSPITAL, BOSTON, MASS

HEPATIC trauma is of rather common occurrence at the present time, as shown by the recent survey by Krieg[1] However, it seemed of interest to report the two following cases because of certain unusual findings The mortality in unoperated cases probably reaches 80 per cent and in those subjected to operation approximately 60 per cent[2] For this reason one must

Submitted for publication June 30, 1937

continuously bear in mind the possibility of such an injury in cases appearing in emergency wards, following accidents

Case 1—J V S, male, age seven, was admitted to the Peter Bent Brigham Hospital August 8, 1936, at 10 A M Shortly before this, the boy had been struck by an auto, the front and rear wheels of one side passing over his body

Physical Examination—The patient was conscious but pale and very restless His extremities were cold and clammy Blood pressure 60 Mm of Hg systolic, pulse 130 The abdomen showed diffuse tenderness and moderate spasticity in both upper quadrants

The patient was placed in moderate Trendelenburg position warm blankets were applied, and he was given 1,000 cc of 5 per cent dextrose intravenously His condition improved somewhat At the end of two hours, in spite of this treatment, his pulse increased, while his blood pressure continued to remain low He was, accordingly, given 200 cc of blood His condition remained unchanged until about 6 P M, at which time there was again an increase in the pulse rate The patient complained of pain in the epigastrium, and at this time a definite increase in the size of the liver could be made out A diagnosis was made of rupture of the liver, and immediate operation advised

Operation—Under ether anesthesia, the abdomen was opened through a midline incision The peritoneal cavity contained a large quantity of blood Exploration revealed that the entire left lobe and a portion of the right lobe of the liver had become nearly completely separated This fracture ran from the point of entry of the round ligament of the liver, posteriorly and to the right, so that approximately one-half the liver substance was lying free, with the exception of a small point on the posterior, upper aspect At this time the patient's blood pressure suddenly fell bleeding was controlled by pressure with a sponge on the raw surface of the liver and he was then given 500 cc of blood It was possible after this to carry out the rest of the operation without undue incident The small bridge of liver tissue which remained was doubly clamped and cut, the raw area of the liver was then closed by means of mattress sutures A narrow gauze drain was introduced and the abdomen was closed in layers

Pathologic Examination — Gross—The weight of the specimen removed was 354 Gm, and measured 17×9×6 cm The liver in a boy of this age according to Coppeletta and Wolbach[a] is 680 Gm, so that in this case approximately one-half the liver substance was lost

On August 9, the day following operation, the patient's condition was good However, his pulse rate was still rather high, and for this reason he was given another small transfusion of whole blood The drain was removed on the seventh postoperative day, and following this there was bile-stained drainage for nearly two weeks The results of the urine and blood chemistry studies were normal throughout his hospital stay Six months after the injury his condition was excellent

Case 2—M L G, female, age 19, was admitted to Lakeside Hospital September 21, 1931, at 6 P M About 5 30 P M, while driving, her car ran off the road, turned over and pinned her beneath it She was able to stand up, and was immediately hospitalized When first seen she seemed in moderate shock, the blood pressure was 90/60, and she seemed cold She was placed in bed and kept warm

Physical Examination showed crepitation at the junction of the cartilage and eighth rib, tenderness over both lower rib margins and board-like abdomen There were also multiple bruises and lacerations At the end of five hours the blood pressure had returned to a normal level and the pulse was 100 However, the white blood count had risen to 19,000, and the red blood count was 3,700,000, hemoglobin 65 per cent

On the following morning her condition was much improved Respiration, pulse, blood pressure and temperature were normal The abdomen was still rigid The patient's condition did not improve during the day and by evening the temperature had risen to 102° F The leukocyte count remained at 19,000, and the red cell count at

3,500,000 There was definite discomfort in the right and left sides Exploratory operation was carried out with the preoperative diagnosis of a ruptured viscus

Operation—Under gas-oxygen-ether anesthesia, the abdomen was opened through a right midrectus incision and was found to be filled with old blood The liver on the right side was normal The blood seemed to be coming from the left upper quadrant, which was found to be filled with bile-stained blood and bile A fragment of necrotic, yellowish liver, as large as the palm of the hand, was lying free on the spleen Another fragment of necrotic liver was still attached to the left lobe of the liver, from which it was almost entirely separated by a large fissure The loose fragment and all possible blood were removed from the abdomen No bleeding points were seen The incision was then closed in layers, without drainage

The postoperative course was uneventful and temperature gradually subsided The wound healed per primum The patient was discharged on the fifteenth postoperative day

The first case is of interest because the patient lost approximately one-half of his liver, and in spite of this an uneventful recovery ensued The fact that the urine showed no gross abnormality indicates a considerable portion of liver must be destroyed before the so-called "liver-kidney" syndrome will appear

In the second case the patient made an uneventful recovery in spite of a piece of necrotic liver which was not removed at the time of the operation There was nothing following operation that would suggest bile peritonitis

REFERENCES

[1] Krieg, E G Hepatic Trauma Analysis of Sixty Cases Arch Surg 32, 907, 1936
[2] Deaver, J B, and Ashhurst, A P C Surgery of the Upper Abdomen 2nd Ed, P Blakiston's Son & Co, 598, 1921
[3] Coppeletta, Joseph M, and Wolbach, S B Body Length and Organ Weights of Infants and Children Am J Path, 9, 55, 1932

MEMOIR

DUNCAN EVE

1853-1937

EIGHT years after retirement from a very active surgical practice and the onerous duties of a teacher of surgery for many years, Duncan Eve died after having completed a distinguished career, February 15, 1937



DUNCAN EVE, M D

He was born at Augusta, Georgia, where his father, famed Paul F Eve, medical hero of six wars, has a monument erected in his memory by Poland for his services as a surgeon in that unhappy country's resistance to Russia He was graduated from the University of Nashville in 1872, where, prior to

the war, his father as Professor of Surgery had taught the largest medical class ever assembled in the South, numbering 454 He was also graduated from Bellevue Medical College in 1874 Shortly after, this ambitious son began his career as a teacher Those were the days when the proprietary medical school was the only source of medical instruction and filled a very important need during that era Medical science had not developed to such a highly technical and comprehensive degree It was the glorification of the preceptorship and taught the practice of medicine and surgery as it was then known The personality of the teachers, together with their experience and judgment, formed the basis of medical teaching Those men were forceful, dynamic, and towering in their dominance of catastrophes Diseases, which they did not wholly comprehend, were treated and often mastered by sheer personality and common sense Doctor Eve, early, had the realization that medicine should be under the aegis of the university

The younger Eve organized the medical department of the University of Tennessee in Nashville in 1880 For many years he was the Dean of the department of surgery His work was prodigious and his fame as a teacher and surgeon was far-flung

In later life he became professor of surgery in Vanderbilt University and still later was instrumental in combining the faculties of the three medical schools then existing in Nashville into Vanderbilt University, at which time the University of Nashville went out of existence and the University of Tennessee Medical Department was transferred to Memphis In this movement, and all others pertaining to the advancement of medicine, Doctor Eve was a great champion He was a gifted organizer and a shining example of the older methods of medical teaching

Doctor Eve lived through the evolution of surgery of the emergencies into the surgery of pathologic conditions with the formal surgical attack based upon the then recent introduction of asepsis and the beginning of modern surgery He was a great figure in the surgical development of the South His colleagues freighted him with many splendid honors He was made president of the state, sectional, and national societies As Vice-President of the American Medical Association, he presided after the death of the president

For many years Doctor Eve was chief surgeon of all the railways centering in Nashville He was instrumental in organizing the first society of railroad surgeons, in Tennessee as well as the Southern States Railway Surgeons As a result of his labors, transportation of the wounded and injured was perfected and their first aid and physical care forwarded A superior authority on fractures, he also was a link between the surgery of the blood vessels and aneurysm and the newer developments in the surgical cure of diseases of the blood vessels He contributed the chapter on aneurysms in Park's "System of Surgery" His name and work have been carried on by Dr Duncan Eve, Jr, his only son

Great hearted, courageous, tireless, and enthusiastic in the practice of surgery and in its teaching, he has left an indelible memory and imbued with high ambition the large classes which he taught from the south and southwest His name was a household one in medicine and one of great distinction in the community where he lived and wrought

WILLIAM D HAGGARD

EDITORIAL ADDRESS

Original typed manuscripts and illustrations submitted to this Journal should be forwarded prepaid at the author's risk, to the Chairman of the Editorial Board of the ANNALS OF SURGERY

Walter Estell Lee, M D
1833 Pine Street, Philadelphia, Pa

Contributions in a foreign language when accepted will be translated and published in English

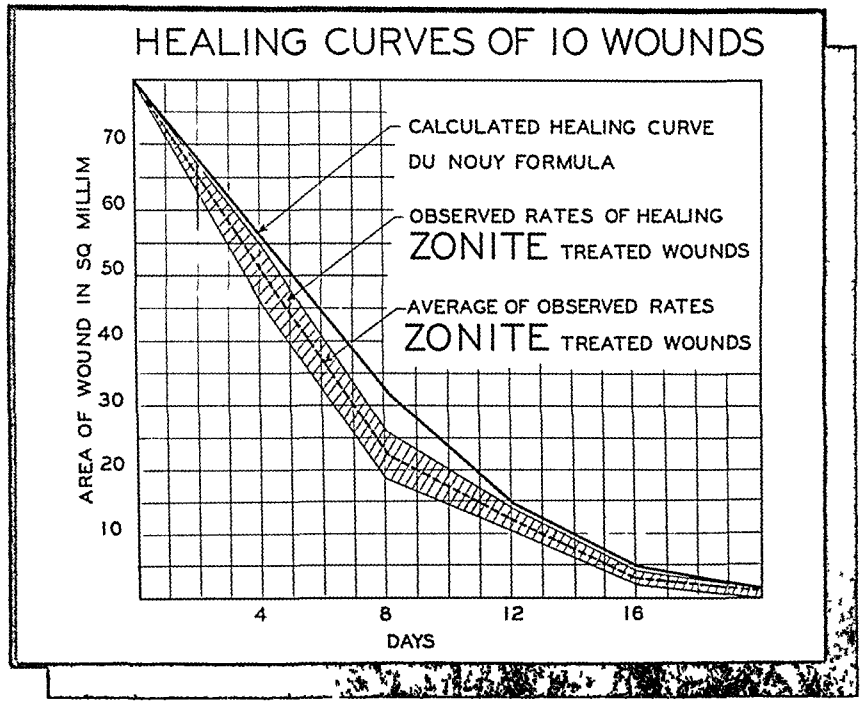
Exchanges and Books for Review should be sent to James T Pilcher, M D , Managing Editor, 121 Gates Avenue, Brooklyn, N Y

Subscriptions, advertising and all business communications should be addressed

ANNALS OF SURGERY
227 South Sixth Street, Philadelphia, Pa

Zonite Meets This Crucial Test

Lecomte du Nouy has developed a mathematical formula whereby the rate of healing of a normal, sterile wound, can be predicted Infection, or irritation with strong germicides causes a deviation from the normal healing curve Zonite destroys infection and does not retard healing



Laboratory tests of bactericidal action—cell-tissue tests—tests for irritation—tests for solvent power on necrotic tissue—do not alone answer the crucial question, *"Does this germicide retard healing?"*

Zonite passes these important laboratory tests. Zonite also meets the exacting requirements of quantitative wound-healing tests, the most accurate index of clinical efficiency.

Zonite establishes normal cicatrization of wounds in accordance with the formula of du Nouy

Zonite, diluted with an equal volume of water, is an improvement on the Dakin solution—ready for instant use—no waiting or testing necessary.



Avoid chemically prepared solutions which are not accurately standardized and which deteriorate rapidly

Avoid substitutes made from organic chlorine compounds which have no solvent action on necrotic tissue and pus cells

SPECIFY ZONITE — THERE IS A GREAT DIFFERENCE!

ZONITE PRODUCTS CORPORATION
34 New Brunswick, N J

Dr

☐ Please send me complimentary bottle of Zonite

☐ I am also interested in special prices to the profession

Street

City State

NOTE When you send in this coupon, please sign personally and clip to your professional letter head This request is made in order to prevent unauthorized persons from obtaining samples

Try this quick, inexpensive method of Post-Graduate Study

For 47 years a distinguished group of surgeons and physicians has been availing itself of a special post graduate service that saves endless time and expense Now this service has been made even more helpful by the addition of other outstanding doctors to the Medical Board of Editors, by a new, easier to read format and by increasing the range of the service

THIS service was the natural outgrowth of the many rapid advances that have forced doctors either to buy too many expensive medical books each year or to spend several weeks visiting clinics Few doctors have the time to do the latter though all want the new information as quickly as possible and many who could afford to attend clinics found the cases so unusual or experimental that much that was learned could not be applied The problem was to find some way to obtain currently the complete comprehensive immediately useful knowledge of new developments new techniques of proven worth so that it could be applied under commonplace conditions by the regular practitioner as well as the specialist

The Answer to an Important Problem

The NEW INTERNATIONAL CLINICS (published quarterly) is the definite answer to this problem In it you receive the important findings in medicine and surgery complete with symptoms analysis technique and treatment Numerous illustrations and charts accompany the text So carefully edited and so thoroughly checked is the material submitted for publication in INTERNATIONAL CLINICS that for the past forty years *every important* advance in medicine and surgery has been reported at once in this quarterly service

A Distinguished Medical Board That Really Edits

The Editor in Chief of the NEW INTERNATIONAL CLINICS is George Morris Piersol Professor of Medicine University of Pennsylvania Now on the new Medical Board are such distinguished men as Clarke of Yale Cecil of Cornell Minot of Harvard Woods of Johns Hopkins McNee of the University College Hospital London Rehn of the University of Freiburg Meakins of McGill Wilder of the Mayo Foundation Moore of the University of Louisville David of Rush Eastman of Johns Hopkins Houser of the University of Pennsylvania Hospital Kerr of California Musser of Tulane Pollock of Northwestern Ravdin of Pennsylvania Veeder of Washington Wallace of New York University and Christopher of Northwestern These men actively participate in checking the findings submitted

The average volume runs well over 300 pages Contributions clinic reports and reviews of progress usually total 25 Each book is handsomely bound

There Is No Need to Send Any Money

To subscribe to INTERNATIONAL CLINICS for 1938 simply fill out and mail coupon below When the March volume arrives study it carefully measure its worth to you In this way you may judge for yourself what a saving it may mean to you If within seven days after you receive it, you still feel that your old method of getting current findings is better notify us, and we will gladly cancel the balance of your subscription There is no need to send money On delivery of each volume you will be billed at the regular price of only $3 per volume (Total cost for one year four volumes is $12 00)

The New March International Clinics Brings YOU.

ORIGINAL CONTRIBUTIONS

Some Observations on the Course and Outcome of Hemorrhagic Nephritis by Warfield T Longcope M D

Vitamin A Deficiency in Adults by Harold Jeghers, M D

Surgical Procedures for Ununited Fractures of the Neck of the Femur by Willis C Campbell, M D

Roentgen Diagnosis in Medical Practice—Its Possibilities and Limitations by Leo G Rigler, M D

Treatment of Wounds by Frederick Christopher, B S, M D

FROM CLINICS

Silk Sutures and Ligatures in Clean Wounds by J M Mason, M D

Transverse Incision of Stewart in Radical Mastectomy by J M Mason, M D

Digitalis in Coronary Artery Disease and in Pneumonia by John H Arnett, M D

Celiac Disease by Joseph S Wall, M D

Perennial Hayfever Diagnosed as Chronic Sinusitis by J H Black, M D

From Reviews of Medical Progress

Biliary Stasis and Decompression A Review of Recent Contributions by A Cantarow, M D

and Others of Importance

The New INTERNATIONAL CLINICS

J B LIPPINCOTT COMPANY, Dept AS3,

227 South 6th Street, Philadelphia, Pa

Please enter my subscription to the 1938 series of INTERNATIONAL CLINICS and bill me at the rate of only $3 00 per volume as each of the four volumes is delivered to me It is understood that I may cancel my subscription to the remaining three volumes if not delighted with the March volume

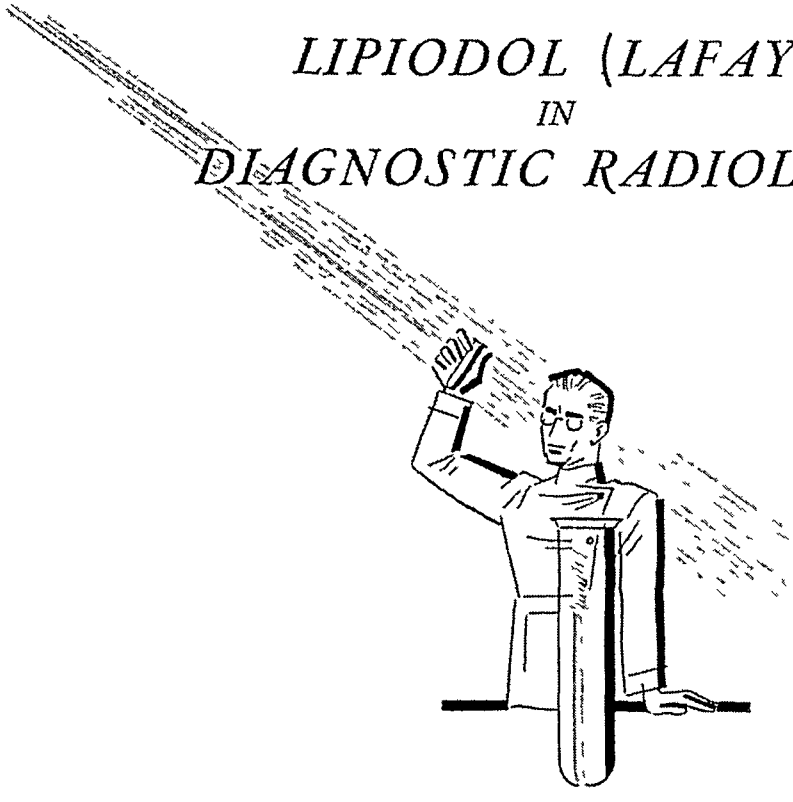
Name

Address

City State

A TRUE IODIZED OIL

LIPIODOL (LAFAY) IN DIAGNOSTIC RADIOLOGY



Lipiodol is not a chloro iodized oil—it contains no chlorine Chemical titration is not necessary to detect deterioration as is the case with chloro iodized oils

These, briefly, are the eight essential features of Lipiodol (Lafay)

1. The original French iodized oil
2. Not a chloro-iodized oil
3. Light amber color — helps detect deterioration
4. Bland and well tolerated even by delicate tissues
5. Relatively non-irritating and non-toxic
6. Precise, clear cut, sharply outlined radiographs
7. Facilitates diagnosis of many obscure conditions
8. Reveals pathologic conditions which ordinary radiographs cannot visualize.

**Iodized Poppy-Seed Oil 40%*

Please send for booklet "Lipiodol in Radiologic Diagnosis"

E FOUGERA & CO., INC., 75 VARICK ST., NEW YORK

LIPIODOL (LAFAY)

Please mention ANNALS OF SURGERY when writing advertisers

STANDARD MEDICAL PUBLICATIONS

NEW (2d) EDITION *JUST READY*

EXTERNAL DISEASES OF THE EYE

By DONALD T ATKINSON, M D, F A C S

Consulting Ophthalmologist to the Santa Rosa Infirmary and the Nix Hospital, San Antonio, Texas Fellow of the American Academy of Ophthalmology and Oto Laryngology, Etc

Octavo, 718 pages, illustrated with 191 engravings Cloth, $8 00, net

This new edition is enlarged and thoroughly revised to include many important innovations in ophthalmic science Among them are those dealing with slit lamp microscopy, orthoptic training, allergic ocular manifestations and many other accessions of equal value The author classifies as external diseases of the eye such conditions as may be diagnosed without the use of the ophthalmoscope These are the conditions which are most frequently encountered The therapeutic procedures are presented clearly and concisely The range of the work is unusually wide and such topics as orbital growth, iritis, cyclitis, glaucoma, cataract, squint and a variety of operative measures receive full consideration The work is unique in its inclusion of reproductions of the author's work with the brush and with modeling wax by which he presents his impressions in a most vivid manner The illustrations are quite as valuable as the text itself in clarifying his ideas The material on the hygiene of the eyes and the inclusion of medical formulae and remedies make the volume as useful to the general practitioner and student as to the specialist

TRAUMA AND DISEASE

Edited by LEOPOLD BRAHDY, B S, M D and SAMUEL KAHN, B S, M D

Physician in Charge of Industrial Diseases and Accidents in the Office of the Corporation Counsel of the City of New York, New York City

Medical Examiner in the Bureau of Workmen's Compensation of the Department of Labor, State of New York, New York City

Octavo, 613 pages, illustrated Cloth, $7 50 net

This book has been written to provide wider and more accurate knowledge of the etiological relationship between trauma and disease The rise of accident rates, the compensation laws and the growth of industrial medicine have all stimulated the demand for such information This work is a symposium to which twenty-four recognized authorities have contributed their knowledge of the relations between trauma and the diseases with which they are most familiar The work develops the underlying principles on which, in any given case, medical opinion may be safely based It shows the effect of a single trauma—either physical or psychic—in producing disease and in influencing its course It supplies the physician confronted with the problem of etiology, with definite facts based on pathological, clinical and laboratory investigation The editors have selected as contributors, eminent teachers and specialists in individual fields of medicine rather than physicians specializing in so called medico legal practice This book presents authoritative data from which more accurate opinions may be formulated

THE EXTRA-OCULAR MUSCLES

A Clinical Study of Normal and Abnormal Ocular Motility

By LUTHER C PETER, A M, M D, Sc D, F A C S

Professor of Diseases of the Eye in the Graduate School of Medicine of the University of Pennsylvania, Ophthalmologist to the Graduate Hospital of the University of Pennsylvania and the Rush Hospital for Consumption and Allied Diseases, etc, Philadelphia, Pa

Second edition Octavo, 351 pages, illustrated with 136 engravings and 5 colored plates Cloth, $4 50, net

This work emphasizes those conditions which are susceptible to treatment The outstanding feature of this edition is the inclusion of an entirely new chapter on operative technique composed largely of principles and practices which the author has himself evolved during his lengthy and successful experience in muscle surgery It is believed that the best results are obtained only through the careful study of the special needs of each patient and the selection of the operation or procedure best suited to his requirement This work offers an ample and varied technique permitting such a selection

LEA & FEBIGER

WASHINGTON SQUARE
PHILADELPHIA, PA

Please send me books checked

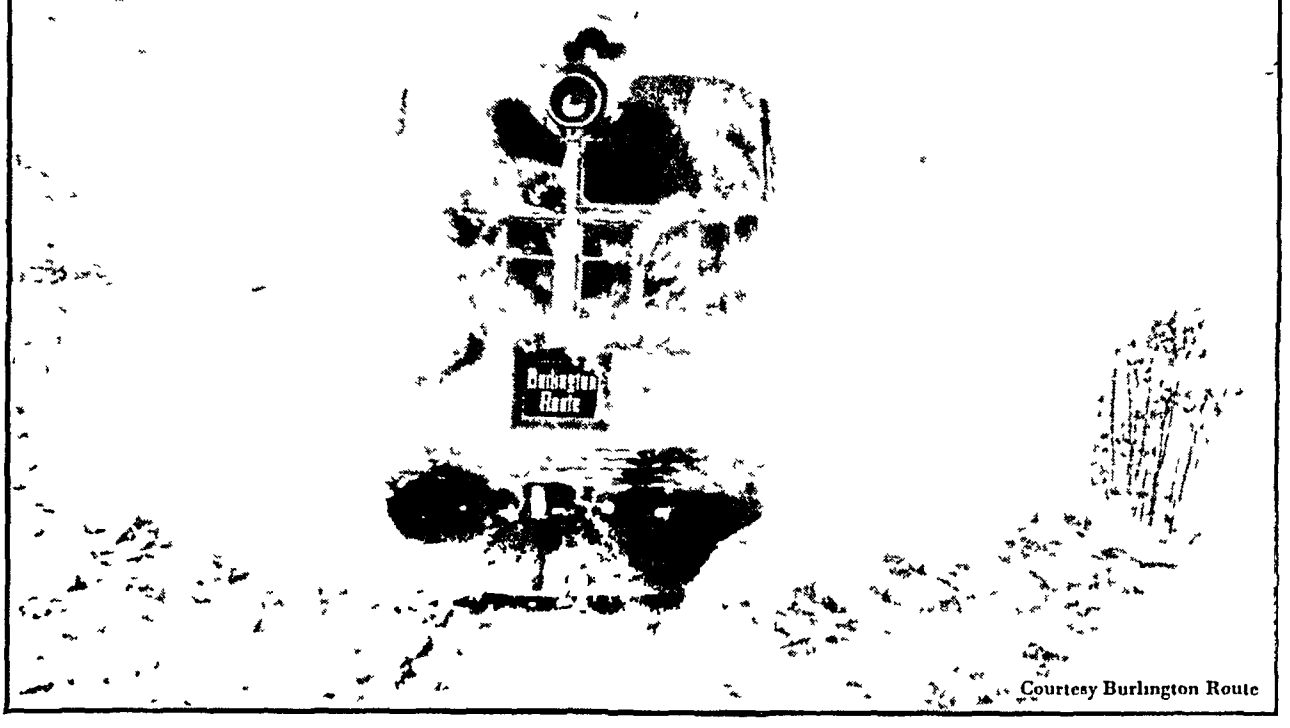
☐ Atkinson's External Diseases of the Eye $8 00
☐ Brahdy & Kahn's Trauma and Disease 7 50
☐ Peter on The Extra-Ocular Muscles $4 50
☐ Catalogue

Name
(A of S 3-38)

Address

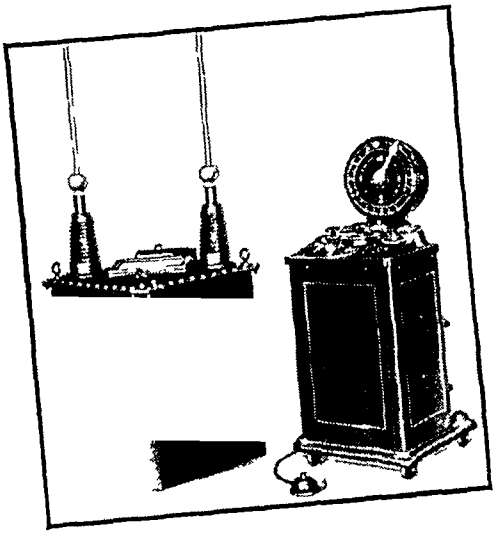
Please mention ANNALS OF SURGERY when writing advertisers

Here's HIGH POWER, HIGH SPEED, under PERFECT CONTROL



Courtesy Burlington Route

and now—whatever your x-ray demand—High Power or Low Power; Long Exposures or Speed, You can have it with PERFECT CONTROL



GENERAL ELECTRIC X-RAY CORPORATION
2012 Jackson Blvd., Chicago, Ill., U.S.A.

• Yes!—Fluoroscopy, long-time low-voltage radiography, or "speed" technics requiring high-milliamperage, you can have them all and with PERFECT CONTROL. If you are now using, contemplate installing, or realize a need for major diagnostic equipment, it will pay you to investigate General Electric's entirely new 500 milliampere Unit, the KX-8 This excellent apparatus offers you many advantages For example

Through its vastly improved means of transformer regulation and precision control, the KX-8 makes high-milliamperage technics practical and simple

Without intricate manipulation, you can enjoy the diagnostic effectiveness that high power in combination with high speed will bring

You can consistently duplicate results with unusual accuracy. With the KX-8, 500-milliampere technics are easy to do and easy to duplicate

Learn how you can obtain increased diagnostic quality with *high power and high speed under perfect control* Without obligation, write today for full information about this new and modern diagnostic x-ray unit, the G E KX-8 Address Dept B23

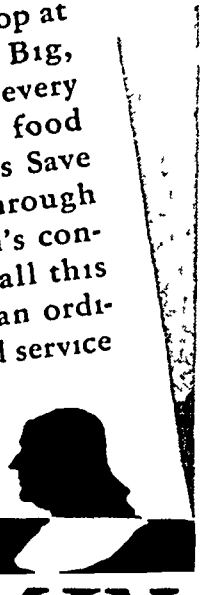
Please mention ANNALS OF SURGERY when writing advertisers



Enjoy the Comfort and Prestige of

PHILADELPHIA'S FOREMOST HOTEL

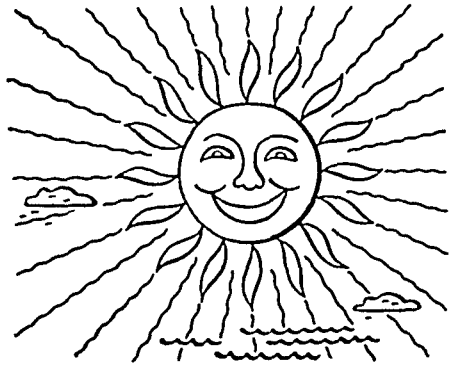
Treat yourself to the best when you visit Philadelphia stop at the Benjamin Franklin. Big, comfortable rooms with every modern comfort Enjoy food that's an epic for epicures Save time and annoyance through the Benjamin Franklin's convenient location Yet all this costs you no more than ordinary hotel comfort and service



The **BENJAMIN FRANKLIN**

PHILADELPHIA'S FOREMOST HOTEL

Samuel Earley MANAGING DIRECTOR



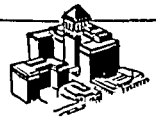
Give them the "Sal-and-Sol" treatment

Generous doses of salt air and sunshine often add the final fillip to recovery Patients also respond heartily to the considerate hospitalities of these beachfront hotels Cheerful, quiet rooms A library, game rooms, and seaside lounges near the elevators Ocean Decks Health baths Trained dietitians will supervise any regimen you prescribe

LEEDS AND LIPPINCOTT COMPANY

CHALFONTE-HADDON HALL

ATLANTIC CITY

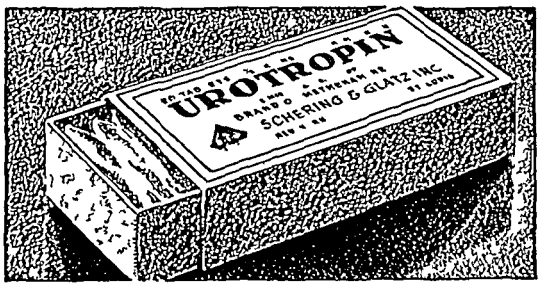


CONFIDENCE

in the dependability of Urotropin has kept it in the foreground as a urinary antiseptic.

There is no urinary antiseptic that has received such unstinted praise as a reliable therapeutic agent in the treatment of pyelitis, cystitis and other infections of the urinary tract ¶ Urotropin, the S &G brand of methenamine, is available in tablets of 5 grains and 7½ grains, packed in sanitape Also in crystals Trial supply on request

Schering & Glatz, Inc , 113 W 18th St , New York City



UROTROPIN

The Journal of Bone and Joint Surgery

The Official Publication of the
American Orthopaedic Association
British Orthopaedic Association
American Academy of Orthopaedic Surgeons
Owned and published by the American Orthopaedic Association

Published Quarterly.
January, April, July, and October

The only publication in English dealing exclusively with bone and joint conditions

Through the cooperation of its Foreign Editors, its pages include contributions from recognized leaders in this specialty from foreign countries as well as from the United States and Canada

In the choice of papers for publication emphasis is laid on the practical and clinical subjects

A journal of value to general surgeons as well as to those dealing with the problems of orthopaedic and traumatic surgery

Editor, E. G. BRACKETT, M.D.
8 THE FENWAY, BOSTON, MASSACHUSETTS, U. S. A.

ORDER BLANK

THE JOURNAL OF BONE AND JOINT SURGERY
8 The Fenway, Boston, Massachusetts

Please enter my subscription to THE JOURNAL OF BONE AND JOINT SURGERY for one year beginning with the issue for

☐ Enclosed find $——— in payment ☐ Will remit on receipt of bill

NAME STREET

CITY STATE

Subscription Price—Payable in Advance—$5.00 in the United States, $5.25 in Canada, $5.75 in Foreign Countries

Please mention ANNALS OF SURGERY when writing advertisers

Where Do They Come From

Some Facts About the Source of Armour's New Process Ligatures and Sutures

● "Where do they come from?" Have you ever asked that question about the sutures and ligatures you are using?

You should know the answer, in detail For the safety and efficiency of any ligature or suture largely depends upon the material from which it is made

Armour's New Process Ligatures and Sutures come from the small intestines of *small, range-fed* lambs



We use the intestines of *small* animals because they alone have the correct uniformity to make good sutures

We insist on *range-fed* lambs for our supply, because they are cleaner and healthier by every important standard

We accept only fresh material from healthy animals which have been U S Government Inspected and passed The Armour Laboratories have, in the Armour packing plants, the world's largest immediate source of fresh raw material



And only the *smooth* side a scant half of these carefully selected intestines goes into Armour Sutures, for only the smooth side is sufficiently close-knit, smooth and strong for high-grade products

Whether or not you use Armour's New Process Ligatures and Sutures, we think you should know these facts We think you should use them as a measuring-stick for your present source of supply



Armour and Company is licensed (license No 078) under the Therapeutic Substance Act of the British Ministry of Health to export Armour Ligatures and Sutures to the British Empire On request, we will gladly send surgeons a booklet describing the entire method of making Armour's New Process Ligatures and Sutures

THE ARMOUR LABORATORIES

Armour and Company, Union Stock Yards, Chicago

Cook County Graduate School of Medicine

(IN AFFILIATION WITH COOK COUNTY HOSPITAL)
Incorporated not for profit

ANNOUNCES CONTINUOUS COURSES

SURGERY—General Courses One, Two, Three and Six Months, Two Weeks' Intensive Course in Surgical Technique with practice on living tissue, Clinical Course Special Courses

GYNECOLOGY—Two Weeks' Intensive Course starting March 28th, Personal Courses

OBSTETRICS—Two Weeks Intensive Course starting April 11th, Informal Course

FRACTURES & TRAUMATIC SURGERY—Informal Practical Course Ten Day Intensive Course starting April 11th

OTOLARYNGOLOGY—Two Weeks Intensive Course starting April 4th

OPHTHALMOLOGY—Two Weeks' Intensive Course starting April 18th Personal Course in Refraction

UROLOGY—General Course One Month Intensive Course Two Weeks Special Courses

CYSTOSCOPY—Ten Day Practical Course

GENERAL INTENSIVE AND SPECIAL COURSES IN ALL BRANCHES OF MEDICINE AND SURGERY

TEACHING FACULTY
Attending Staff of Cook County Hospital

Address Registrar 427 South Honore Street, Chicago, Illinois

NEW SECOND EDITION

DISABILITY EVALUATION
Principles of Treatment of Compensable Injuries

By

EARL D McBRIDE
BS, MD, FACS

Assistant Professor in Orthopedic Surgery, University of Oklahoma School of Medicine

Octavo 623 pages 374 illustrations Cloth, $8

The purpose of this volume is to interpret the physiological and mechanical alterations arising out of injury to the motor structures of the human body, and to reasonably appraise and evaluate the extent of functional loss as it relates to the economic incapacity of the injured

This book stresses the effect of physiological and mechanical alterations and draws conclusions as to the loss of function by evaluating the factors which compose function It gives a method of measuring the extent of disability in a given case

Practical, usable, new

J. B. LIPPINCOTT COMPANY
PHILADELPHIA

Drink

Coca-Cola

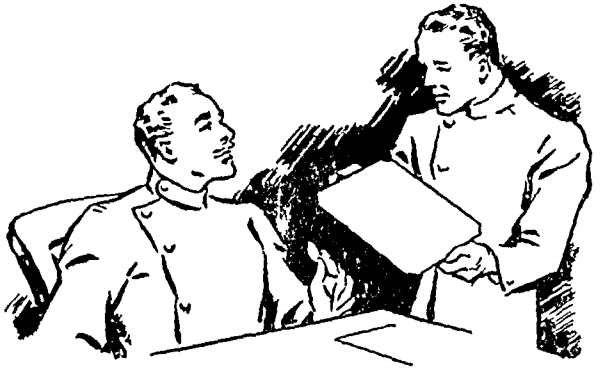
Delicious and Refreshing



Pure refreshment

DR. X AND DR. Z DISCUSS

X-ray Intensifying Screens



DOCTOR X—"Well, I agree with you doctor, speed in radiography is essential"

DOCTOR Z—"Yes, I believe that the combination of speed and contrast made possible by the use of X-ray Intensifying Screens is their outstanding advantage"

DOCTOR X—"Certainly nobody can quarrel with that statement But, personally, I feel that there are other important advantages to the use of intensifying screens"

DOCTOR Z—"There's no doubt about that I think that the Patterson Screen people hit the nail on the head when they said that 'Intensifying Screens assure BALANCED RADIOGRAPHY'"

X-RAY INTENSIFYING SCREENS ASSURE BALANCED RADIOGRAPHY

1 They greatly reduce exposure time
2 They greatly reduce danger of movement
3 They minimize danger of over-exposure to patients
4 They permit larger number of repeat exposures
5 They assure a high degree of detail and maximum contrast
6 They greatly reduce wear and tear on expensive X-ray tubes and equipment

Patterson X-ray Screens assure Balanced Radiography plus radiographs of highest possible quality

THE PATTERSON SCREEN CO., TOWANDA, PA

Patterson

INTENSIFYING **Screens** FLUOROSCOPIC

PATTERSON . . . THE WORLD'S STANDARD FOR HIGHEST SCREEN QUALITY

"REQUIRED READING"

Your Personal Guide to a More Successful Practice

Dr George D Wolf is a highly successful physician who decided it was high time that someone put out a book that showed the doctor how to put his profession on a more profitable basis The result is one of the most important books any doctor can have—a book that answers and clarifies hundreds of questions and problems regarding business ethics and economics constantly confronting the busy doctor

The volume should be carefully read by the physician's secretary or office nurse as well, as much of the information and suggestions tendered in it can be applied and put into service without any instruction from the doctor whatsoever There is also a particularly useful section devoted to material teaching nurses how to give instructions to patients for home self treatment Nothing has been omitted It is all there for you—from How to make a Radio Talk to How to Give Expert Court Testimony Every doctor will find a single reading worth many times the book's cost to him Price only $5 00

DO YOU KNOW

How to go about collecting money from patients who fail to pay?
How to make your office secretary or nurse do many of the things you now must do yourself?
How to equip and plan your office to make it most efficient?
How to pick a profitable location and lay out your office?
How to avoid lawsuits?
How to keep records for your income tax?

THE PHYSICIAN'S BUSINESS

by

GEORGE D. WOLF, M.D.

Attending Otolaryngologist, Sydenham Hospital, New York City Attending Laryngologist, Riverside Hospital, New York City, Fellow, New York Academy of Medicine, Fellow, American Medical Association, etc

Ready Soon!

"There is no finer book on the subject"

Dr Bacon's new book is comprehensive, practical and authoritative It offers an unbiased, informative description of the diversified conditions included in proctologic practice, and covers every phase of the subject It emphasizes the application of the procedure to the patient—not the patient to the procedure *487 illustrations (mostly originals) crisply picture the author's wide clinical and surgical experience*

Dr Bacon's text stresses the underlying pathology of the Anus, Rectum and Sigmoid Colon as basic to treatment He describes the various methods of examinations Diseases are detailed, giving Definition, Etiology, Symptoms, Diagnosis, Medical and/or Surgical Treatment Particular attention is given to Hemorrhoids and to Tumors, including infectious, benign and malignant tumors of the sigmoid and rectum A comprehensive, selected bibliography completes each chapter 600 pages 487 illustrations

ANUS, RECTUM AND SIGMOID COLON

Diagnosis and Treatment

by

HARRY E. BACON, M.D.

F A C S, F A P S, Assistant Professor of Proctology, Temple University School of Medicine, Associate in Proctology, Graduate School of Medicine, University of Pennsylvania

Foreword by

J P LOCKHART MUMMERY, M A, M B, B Ch (Cantab), F R C S (Eng), Emeritus Surgeon, St Mark's Hospital, London, England

Published by

J. B. LIPPINCOTT COMPANY

Washington Square Philadelphia



Mallinckrodt Cyclopropane may also be obtained through the various offices of the Puritan Compressed Gas Corporation

Mallinckrodt
CHEMICAL WORKS

ST LOUIS NEW YORK TORONTO
CHICAGO PHILADELPHIA MONTREAL

Effective Anesthesia *with*

AMPLE OXYGEN *gives* CYCLOPROPANE *(Mallinckrodt)*

Wide Scope and Utility

Small percentages of anesthetic gas in the presence of excess oxygen characterizes the anesthesia with Cyclopropane (Mallinckrodt) Respiratory calmness and cardiac stability contribute to the "elasticity" of Cyclopropane anesthesia

CYCLOPROPANE for ANESTHESIA is relatively safe and widely adaptable in competent hands Adequate relaxation unhampered by labored breathing is appreciated in thoracic and abdominal surgery In obstetrics, especially for cesarean sections, difficult forceps deliveries, and postpartum repairs, the plentiful oxygen is indicated

CYCLOPROPANE for ANESTHESIA (Mallinckrodt) is produced from propane by progressive thermal dichlorination according to a newly developed process Mallinckrodt has perfected a convenient container and recommends the "re breathing" and "closed circuit" types of administration

Send for new brochure
"Cyclopropane for Anesthesia" (Mallinckrodt)

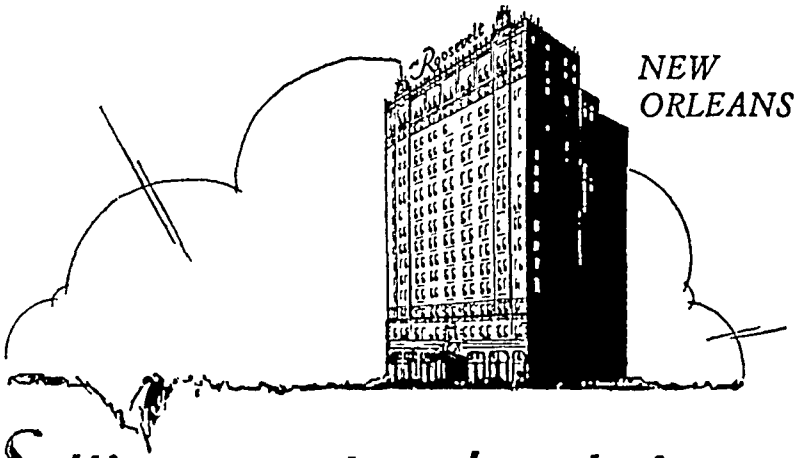
Protecting the Potency of Your Presciptions Since 1867

MALLINCKRODT CHEMICAL WORKS

2nd & Mallinckrodt Streets, St Louis, Mo — 72 Gold Street, New York, N Y
(address nearest office)

I should like your latest Brochure "Cyclopropane for Anesthesia" (Mallinckrodt)

Name
Street
City *State* AS3



Setting a standard in

HOTEL ACCOMMODATIONS

Leadership always carries with it the obligation to be more, to do more and give more

As applied to The Roosevelt, New Orleans, leadership means a completely equipped hotel where the traveler finds refinements and luxuries that add so much to the comfort and pleasure of his stay It means better accommodations and service, and finer food for the dollars you spend 800 rooms with bath Moderate rates

Write or Wire Reservations
JAS PAT O SHAUGHNESSY V-P & Gen Mgr

Order Pralines by Mail

Full halves of selected Louisiana Pecans in a luscious layer of pure Louisiana Cane Sugar New Orleans famous Candy made from the recipe of the Old Plantation Mammy Two attractive gift boxes

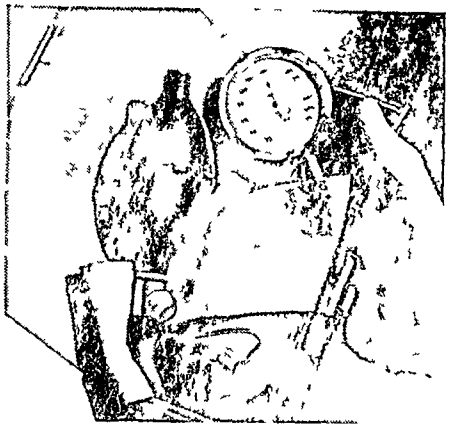


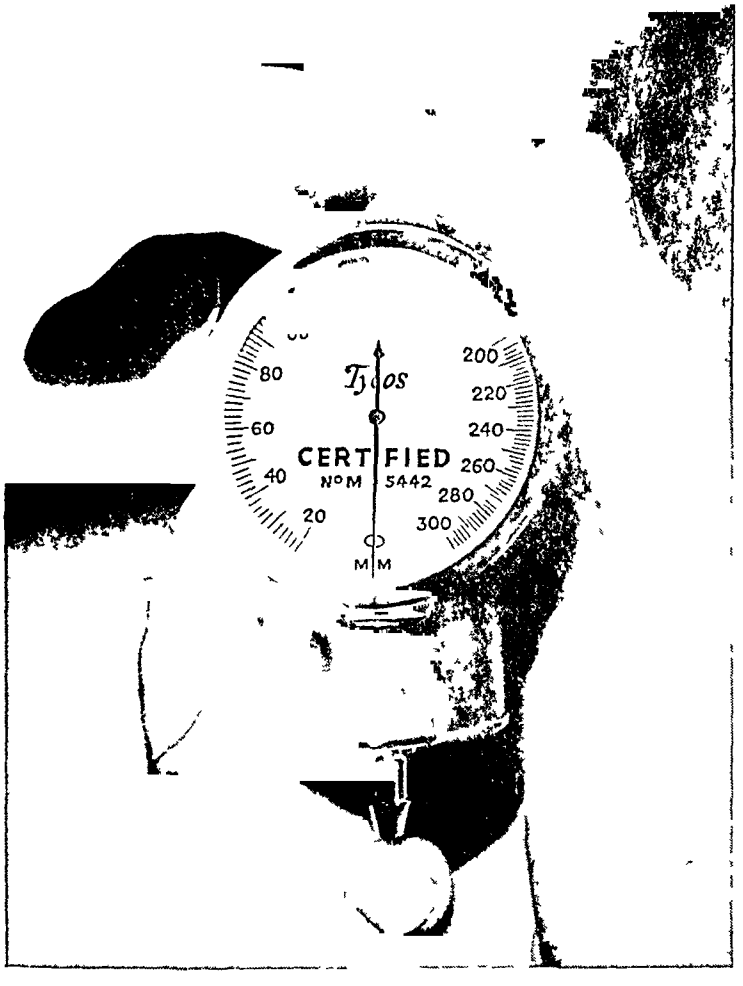
Souvenir Cotton Bale Package 10 Pralines for $1 75 Postage paid *Plantation Mammy Package* 12 Pralines, $1 50 Postage paid Send Money Order or personal check with order to *The Roosevelt Hotel* New Orleans

The Roosevelt
HOTEL
Pride of the South,

YOU WIN

when you own a Certified Tycos Aneroid, the widely used portable sphygmomanometer with 10-Year Triple Guarantee





Portable Tycos Aneroid Sphygmomanometer, **$25 00** *complete*

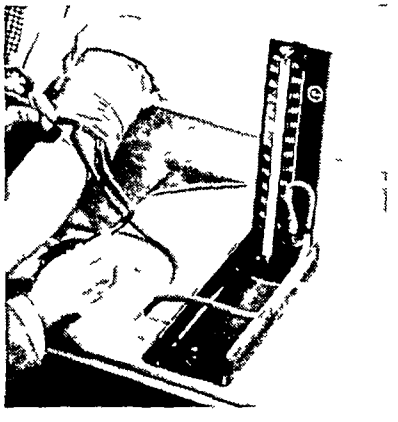
COMPLETE PORTABILITY, ease of use, accuracy in any position—these are the features which make the Certified Tycos Aneroid famous It never requires testing for accuracy so long as the pointer remains in the oval at the bottom of the dial

The 10-Year Triple Guarantee is Taylor's assurance to you of long, accurate, dependable service Remember the three important points this guarantee covers That your Tycos will always remain accurate in normal use that it will tell instantly if thrown out of adjustment that it will be corrected without charge if thrown out of adjustment

Save $5 by taking advantage of the Tycos Exchange Plan Turn in your old sphygmomanometer and receive a $5 allowance towards a new Tycos Aneroid This allowance is yours whether you choose the portable type shown here or the smart-looking desk model See your surgical supply dealer for full details Taylor Instrument Companies, Rochester, N Y Also Toronto, Canada

SMALLEST MERCURIAL MADE

is the Tycos It is amazingly durable It is the only mercurial with an unlimited time guarantee on accuracy and with a 10-Year Guarantee against breakage or mechanical failure of any part except the inflation system You can obtain your Tycos Mercurial under the liberal Tycos Exchange Plan Get the full details *Price*—$27 50 complete



CERTIFIED Tycos INSTRUMENTS

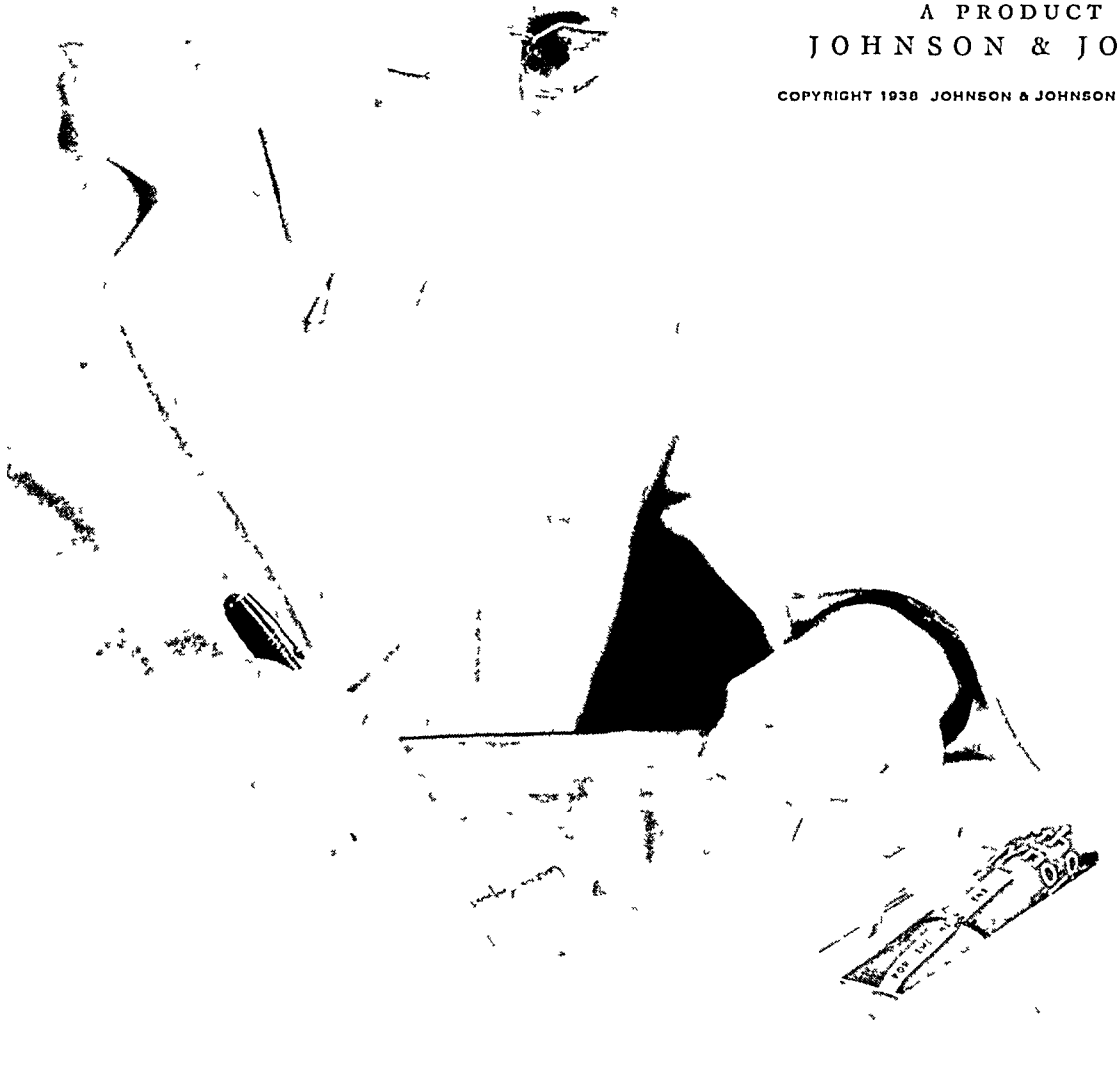
WITH 10-YEAR GUARANTEE

A prescription of

Ortho-Gynol has been prescribed by thousands of physicians, indicating their confidence in the merit of the product and the ability of its makers to produce a good vaginal jelly Ortho-Gynol meets the high requirements of such a jelly The new measured-dose applicator adds to convenience in use Reasonably priced and supplied in lettered or plain packages, with or without applicator

A PRODUCT OF
JOHNSON & JOHNSON

COPYRIGHT 1938 JOHNSON & JOHNSON



VOL 107 MAY, 1938 NO 5

ANNALS of SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

Also the Official Publication of the American Surgical Association, the Southern Surgical Association, Philadelphia Academy of Surgery, and New York Surgical Society

EDITORIAL BOARD

WALTER E LEE, M D
Chairman, *Philadelphia*

BARNEY BROOKS, M D
Nashville, Tenn

E D CHURCHILL, M D
Boston, Mass

EVARTS A GRAHAM, M D
St Louis, Mo

ROSCOE R GRAHAM, M D
Toronto, Canada

SAMUEL C HARVEY, M D
New Haven, Conn

ROY D McCLURE, M D
Detroit, Mich

GEORGE P MULLER, M D
Philadelphia

H C NAFFZIGER, M D
San Francisco, Cal

D B PHEMISTER, M D
Chicago, Ill

W F RIENHOFF, JR , M D
Baltimore, Md

A O WHIPPLE, M D
New York

JAMES TAFT PILCHER, M D , Managing Editor

J B LIPPINCOTT COMPANY, *Publishers*

PHILADELPHIA MONTREAL LONDON NEW YORK

Entered at the Post Office at Philadelphia and admitted for transmission through the mails at second class rates
Price $10 00 a year Copyright 1938, by J B Lippincott Company, 227–231 South Sixth Street Printed in U S A

CONTENTS—*Continued*

CARCINOMA OF THE STOMACH WITH SPECIAL REFERENCE TO TOTAL GASTRECTOMY — Arthur W Allen, M D, Boston Mass — 770

DIVERTICULA OF THE JEJUNUM — John C A Gerster, M D, New York N Y — 783

THE COMPLICATING EFFECTS OF DIVERTICULITIS OF THE COLON UPON ABDOMINAL SURGERY AND ESPECIALLY UPON SURGERY OF THE LARGE BOWEL — Vernon C David, M D; R Kennedy Gilchrist, M D, Chicago Ill — 801

THE SURGICAL TREATMENT OF INTRACTABLE, CHRONIC ULCERATIVE COLITIS — Henry W Cave, M D, New York N Y — 806

THE RETROPERITONEAL (RETROCOLIC) APPENDIX — William B Marbury, M D, Washington D C — 819

UNILOCULAR CYST OF LIVER — Edward H Ochsner, B S, M D, Chicago Ill — 829

PTOSED SPLEEN WITH TORSION OF PEDICLE — Elmer H Adkins, M D, Miami Fla — 832

(*Contents continued on page 6*)

do you treat
CANCER?

THE RADIUM EMANATION CORPORATION

MAINTAINS the most efficiently organized Radium laboratory to make available to you, at low cost, every facility for the use of Radium in your practice

RADON SEEDS Removable or permanent We provide seeds of the composite type, with Radon under leak-proof glass seal Filtration 0 3 mm of Platinum

APPLICATORS Uterine tubes, cervical applicators, surface plaques properly prepared to meet the requirements of each individual case

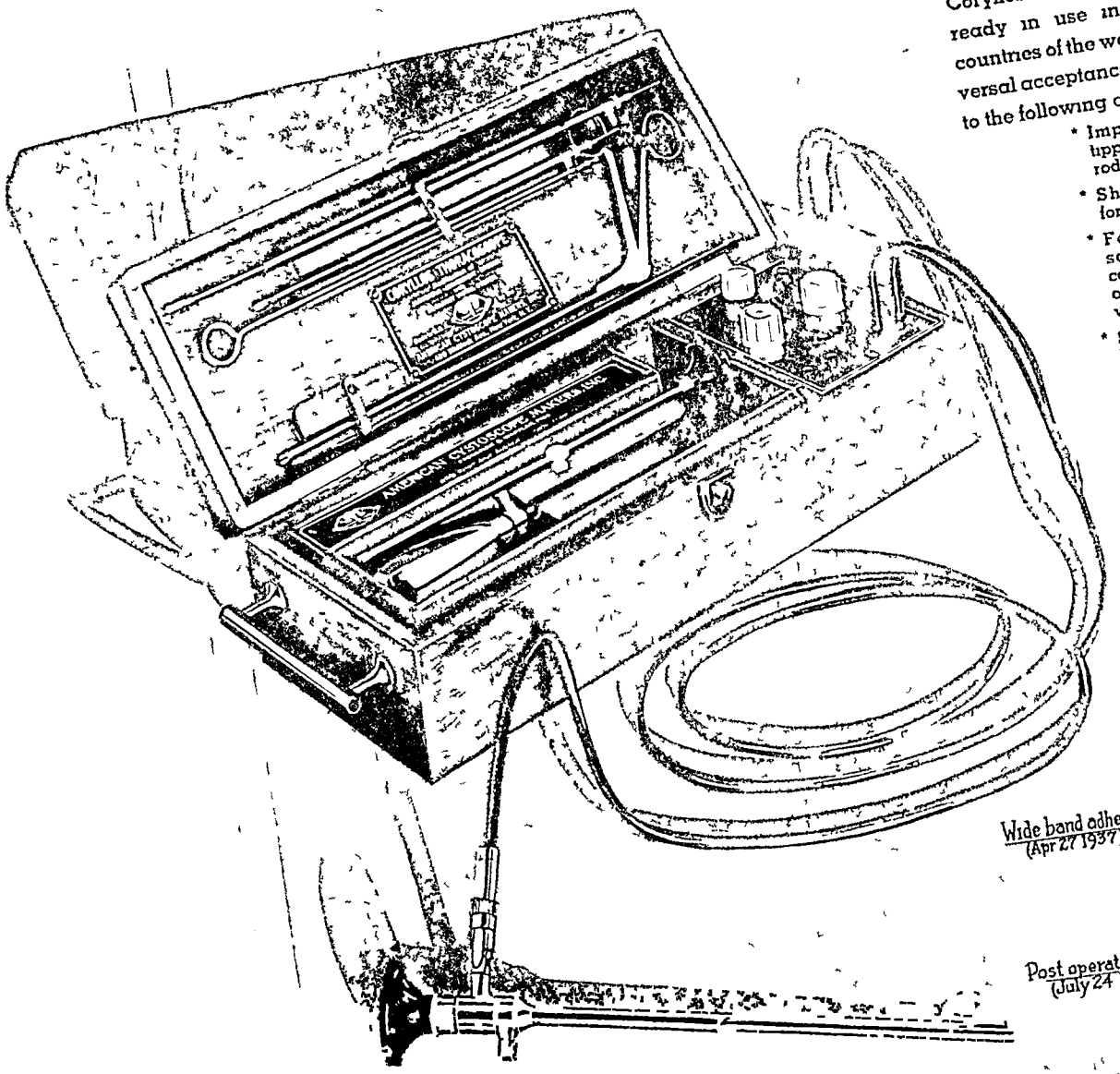
OUR SERVICE is available to you day and night including Sundays and holidays Your inquiries and orders will receive our prompt and careful attention

THE RADIUM EMANATION CORPORATION

GRAYBAR BLDG **Tel MOhawk 4-6455** **NEW YORK, N Y**

CORYLLOS THORACOSCOPE

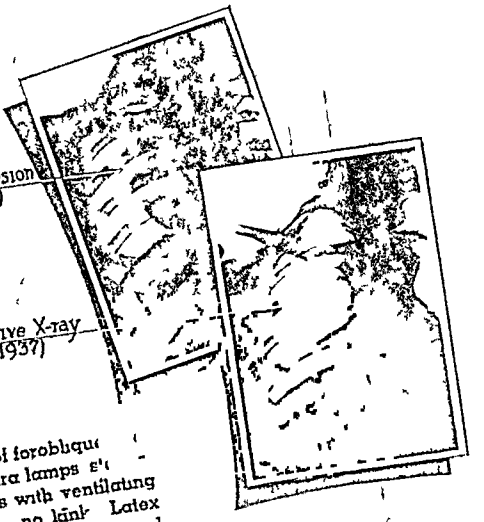
with self contained cautery transformer and light source



Although relatively new the Coryllos Thoracoscope is already in use in 12 different countries of the world Such universal acceptance is in part due to the following advantages

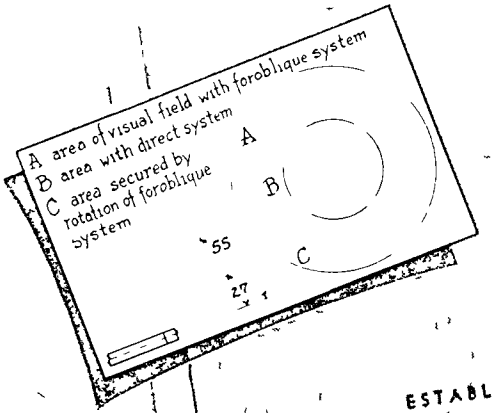
* Improved platinum tipped cautery electrodes
* Shockproof transformer
* Foroblique telescope resulting in complete elimination of lamp from field of vision
* Switch in cautery handle permits complete operator control

* Foroblique is our registered trade mark to designate our obliquely forward telescopic visual system



Wide band adhesion (Apr 27 1937)

Post operative X-ray (July 24 1937)



Coryllos Thoracoscope catalogue no 600, consisting of foroblique scope trocar 2 cannulae, light carrier and lamp, 2 extra lamps g[illegible] able lighting cord long and short cautery electrodes with ventilating shields sterilizable cautery cord and switch handle no link Latex connecting tube with Luer lock connecting nipples insufflation bulb and cleaning rod in walnut case with built in cautery and light transformer $175 00

Note —Biopsy specimen forceps and infiltration needle as illustrated at light additional cost

Write for complete literature with Coryllos Technique

ESTABLISHED IN 1900 BY REINHOLD H. WAPPLER

FREDERICK C WAPPLER PRESIDENT

AMERICAN CYSTOSCOPE MAKERS, INC

450 WHITLOCK AVE NEW YORK U S A

CONTENTS—*Continued*

A COMPARISON OF THE THREE TYPES OF HYSTERECTOMY — Curtis H Tyrone, M D, New Orleans La — 836

A SIMPLE METHOD OF CONSTRUCTING A VAGINA — Lawrence R Wharton, M D, Baltimore Md — 842

POSTERIOR VAGINAL HERNIA — William T Black, M D, Memphis Tenn — 855

VAGINAL CYSTS — Robert L Sanders, M D, Memphis Tenn — 863

MEMOIRS

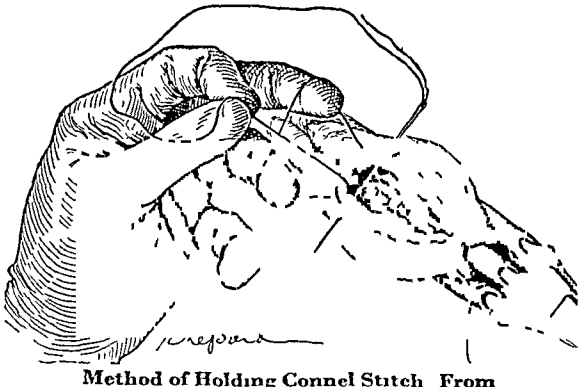
WILLIAM HALL GOODWIN — Stephen H Watts, M D — 872

JAMES KNOX SIMPSON — Gerry R Holden, M D — 874

JAMES ERNEST STOKES — Hubert A Royster, M D — 876

NATHAN WINSLOW — Arthur M Shipley, M D — 879

Actual Practice in Surgical Technique



Method of Holding Connel Stitch From Principles of Operative Surgery, by A V Partipilo, M D

Special Courses—

Urology Cystoscopy Orthopedic Surgery Thoracic Surgery Surgical Pathology Laboratory Diagnosis and Technique Bronchoscopy Eye, Ear, Nose, and Throat Goiter Surgery Gynecology Surgical Anatomy Proctology

Visitors always welcome

CHICAGO POST-GRADUATE SCHOOL OF SURGERY

(Formerly—Laboratory of Surgical Technique)

(Incorporated not for profit)

Near Cook County Hospital

1 Two Weeks Surgical Technique Course rotary course continued throughout the year Combines Clinical Teaching and ACTUAL PRACTICE BY THE STUDENTS under competent supervision A review of the necessary Surgical Anatomy is embraced in the work

2 General Surgery One to Three Months Course designed for students who wish to review more thoroughly Anatomy, Surgical Pathology, Surgical Technique, and Clinical Surgery

3 Special instruction and practice in the technique of one or more operations is available to surgeons who wish to review the Anatomy and Technique of certain operations

Personal Instruction Actual Practice Operating Rooms, Equipment and Method of Teaching Ideal and Unsurpassed For information as to Courses Fees, Registration Requirements Etc, address

A V PARTIPILO, M D, F A C S, Director, 1950 S Ogden Ave, Chicago, Ill, Phone Haymarket 7044

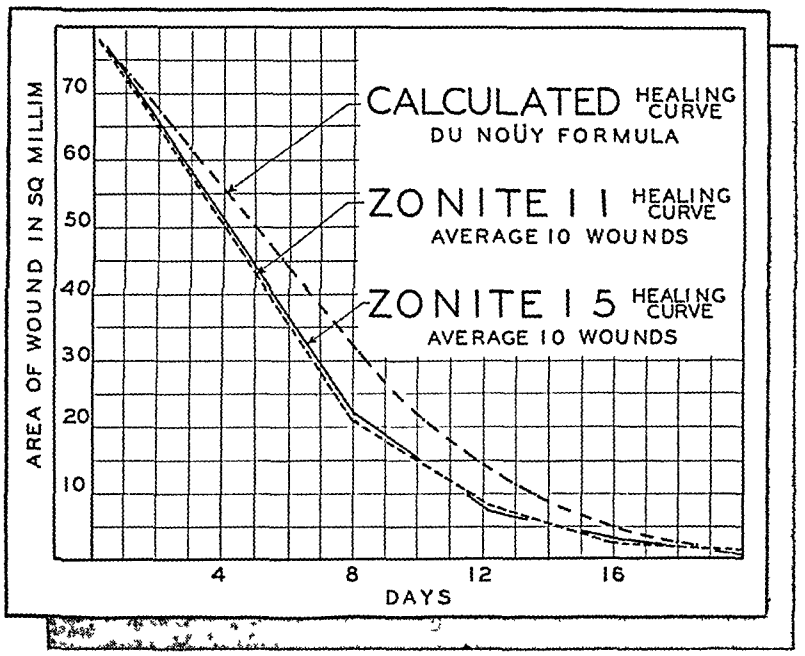
Please mention ANNALS OF SURGERY when writing advertisers

Zonite Meets This Double Test

These curves prove two things about Zonite —

(1) Zonite promotes normal healing without retardation

(2) Zonite 1 1 (0 5% available chlorine concentration —equivalent to Dakin's solution) does not harm tissues under repair Zonite 1 5 (0 2% available chlorine) shows almost identical healing curve as Zonite 1 1 (0 5% available chlorine) In fact, the two curves actually cross



Laboratory tests of bactericidal action—cell-tissue tests—tests for irritation—tests for solvent power on necrotic tissue—do not alone answer the crucial question, *"Does this germicide retard healing?"*

Zonite passes these important laboratory tests. Zonite also meets the exacting requirements of quantitative wound-healing tests, the most accurate index of clinical efficiency. Zonite destroys infection and does not retard healing. *Zonite establishes normal cicatrization in accordance with the formula of Du Nouy*

Zonite, diluted with an equal volume of water, is an improvement on the Dakin solution—ready for instant use—no waiting or testing necessary



Avoid chemically prepared solutions which are not accurately standardized and which deteriorate rapidly.

Avoid substitutes made from organic chlorine compounds which have little or no solvent action on necrotic tissue and pus cells

SPECIFY ZONITE — THERE IS A GREAT DIFFERENCE!

ZONITE PRODUCTS CORPORATION
54 New Brunswick, N J

Dr

☐ Please send me complimentary bottle of Zonite

Street

☐ I am also interested in special prices to the profession

City State

NOTE When you send in this coupon, please sign personally and clip to your professional letterhead This request is made in order to prevent unauthorized persons from obtaining samples

The GRÜSS Rethreadable NEEDLE

SUTURE INSERTED THREADING COMPLETED

Short End Pared Off



TRIAL OFFER *Write today for 1 dozen* needles on approval If not returned to us in 30 days we will mail bill Please state type of needles desired

SECURELY HOLDS A SINGLE SUTURE

Gruss Continuous Suture Needles reduce trauma to such an extent that largest needles with coarsest silkworm gut may be passed through tissue without aid of forceps Suture is held so firmly that hazard of loss during use is entirely eliminated May be *rethreaded* Types and sizes for all uses, all sutures

DEPT. D

GRÜSS SURGICAL MFG. CO.

163 SECOND STREET, SAN FRANCISCO, CALIFORNIA

Ravdin and Coates Translation

OPERATIVE SURGERY

VOL. III: The Ear, Nose, Pharynx, Larynx, Trachea, Bronchi, Esophagus and Neck

The newest volume (June 1937) in what surgeons generally consider the outstanding surgical series of our times Covers the surgery of the ear and respiratory passages, together with that of the neck, the esophagus and cervical areas, with highly significant discussion of the thyroid gland and thymus, exophthalmic goiter and other subjects for surgical intervention on the head and upper body Every detail for operative procedure is beautifully illustrated and clearly described 459 illustrations, mostly in color 528 pages $12 00

Edited by **MARTIN KIRSCHNER, M.D.**

Professor of Surgery and Director of the Surgical Clinic, *University of Tubingen, Germany*

Washington Square Philadelphia **J. B. LIPPINCOTT COMPANY** Medical Arts Bldg Montreal

INDEX TO ADVERTISERS

	Page
SURGICAL SUPPLIES	
American Cystoscope Makers, Inc	5
Bard-Parker Company, Inc	17
Grüss Surgical Mfg Co	8
Kny-Scheerer Corporation	Inside Back Cover
George P Pilling & Son Co	9
Sanborn Company	10
J Sklar Mfg Company	Back Cover
Taylor Instrument Companies	23
LIGATURES	
Davis & Geck, Inc	16
Davis & Geck, Inc	Insert 8-9
Johnson & Johnson	15, 28
C De Witt Lukens	16
X-RAY PLATES	
General Electric X-Ray Corp	19
Patterson Screen Company	21
Radium Emanation Corporation	4
PHARMACEUTICAL SUPPLIES	
Anglo-French Drug Co , Inc	Inside Front Cover
Armour Laboratories	25
Coca-Cola	26
Cutter Laboratories	3
Hoffmann-LaRoche, Inc	12
Eli Lilly & Company	13
Loeser Laboratory	Back Cover
Petrolagar Laboratories, Inc	11
Purdue Frederick Company	Inside Back Cover
E R Squibb & Sons	14
Winthrop Chemical Co , Inc	18
Zonite Products Corporation	7
HOTELS	
Benjamin Franklin	24
Chalfonte-Haddon Hall	9
Hotel Dennis	24
Hotel Roosevelt	27
PUBLISHERS	
Lea & Febiger	20
J B Lippincott Company	8, 10, 22, 26
SCHOOLS	
Chicago Post-Graduate School of Surgery	6
Cook County Graduate School of Medicine	10



DIONYSIO DACA CHACON (1510-1596) was born in Valladolid, Spain, started to practice surgery at the age of twenty and later became personal physician to Charles V and Philip II. He wrote extensively on all aspects of surgery. His "*Tratado de Cirujia*" contains a special chapter on sutures and ligatures, and gives an interesting account of difficulties encountered through the necessity of maintaining a kneeling position while operating on royalty.

D&G Sutures

"THIS ONE THING WE DO"

DAVIS & GECK INC

Special D&G Sutures

WITH SWAGED-ON ATRAUMATIC NEEDLES

THIS group of products comprises over a hundred suture and needle combinations specially designed for specific procedures, particularly those in which minimized suture trauma and the convenience of needles which cannot possibly become unthreaded, are desirable A few products from this group are shown on these pages Full information on others may be obtained from your dealer or by mail from us, upon request

Intestinal Sutures

KALMERID plain or chromic catgut, celluloid-linen or silk with Atraumatic needles in the several types indicated integrally affixed Suture lengths 36 inches for products 1342, 1352, 1372 and 1542, all others 28 inches

THERMO-FLEX *(non-boilable)*

Plain Catgut

NO		NEEDLE	DOZEN
1501	Straight Needle	A-1	$3 60
1503	⅜-Circle Needle	A-3	4 20
1504	Small ½-Circle Needle	A-4	4 20
1505	½-Circle Needle	A-5	4 20

20-Day Chromic Catgut

1541	Straight Needle	A-1	$3 60
1542	Two Straight Needles	A-1	4 20
1543	⅜-Circle Needle	A-3	4 20
1544	Small ½-Circle Needle	A-4	4 20
1545	½-Circle Needle	A-5	4 20

CLAUSTRO-THERMAL *(boilable)*

Plain Catgut

1301	Straight Needle	A-1	$3 60
1303	⅜-Circle Needle	A-3	4 20
1304	Small ½-Circle Needle	A-4	4 20
1305	½-Circle Needle	A-5	4 20

20-Day Chromic Catgut

1341	Straight Needle	A-1	$3 60
1342	Two Straight Needles	A-1	4 20
1343	⅜-Circle Needle	A-3	4 20
1344	Small ½-Circle Needle	A-4	4 20
1345	½-Circle Needle	A-5	4 20

Intestinal Sutures *(cont'd)*

Celluloid-Linen

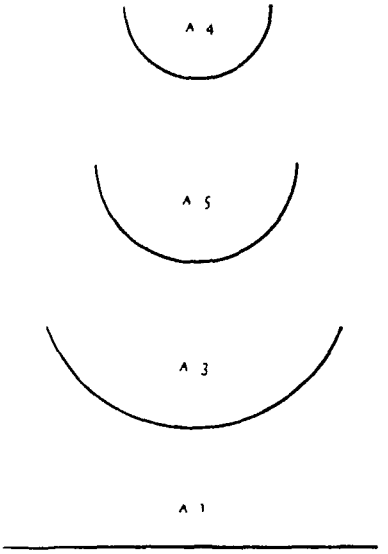
NO		NEEDLE	DOZEN
1351	Straight Needle*	A-1	$3 60
1352	Two Straight Needles*	A-1	4 20
1354	Small ½-Circle Needle*	A-4	4 20

Black Silk

1371	Straight Needle*	A-1	$3 60
1372	Two Straight Needles*	A-1	4 20
1374	Small ½-Circle Needle*	A-4	4 20

Sizes 00 0 1, except *00 0 only

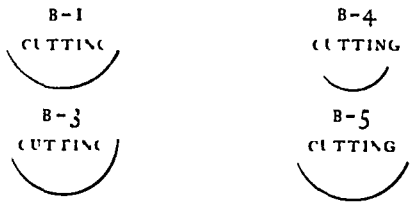
In packages of 12 tubes of a kind and size



DIAMETERS 0 2 TO 026

Eye Sutures

FINE sizes of plain, 10-day chromic catgut, and black silk with small Atraumatic needles Suture length 18 inches except as noted Boilable

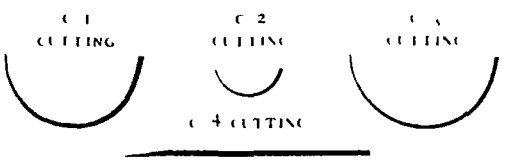


NO	MATERIAL	SIZE	NEEDLE
1661	Black Silk	6-0	B-3
1663	Plain Catgut	4-0	B-5
1665	Black Silk	6-0	B-1
1665	Black Silk	4-0	B-1
1667	Plain Catgut	3-0	B-4
1669	10-Day Catgut	4-0	B-5
1669	10-Day Catgut	3-0	B-5
1669D	10-Day Catgut †	4-0	B-5
1669D	10-Day Catgut †	3-0	B-5
	DOUBLE ARMED		
1662	Black Silk *	6-0	B-3
1664	Black Silk *	6-0	B-1
1664	Black Silk *	4-0	B-1
1666	Plain Catgut *	3-0	B-4
1668	10-Day Catgut *	4-0	B-5
1668	10-Day Catgut *	3-0	B-5
1668D	10-Day Catgut †	4-0	B-5
1668D	10-Day Catgut †	3-0	B-5

* 12 inches † 9 inches

Package of 12 tubes of a kind $4 20

Cleft Palate and Harelip Sutures



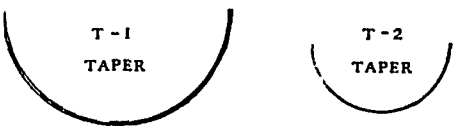
NO	MATERIAL	SIZE	NEEDLE
1751	Kal-dermic	00	C-1
1752	Aluminum-Bronze Wire	00	C-1
1753	Black Braided Silk	000	C-2
1754	Aluminum-Bronze Wire	00	C-4
1755	Kal-dermic	00	C-3
1758	Aluminum-Bronze Wire	00	C-3

Suture length 18 inches

Package of 12 tubes of a kind $4 20

Thyroid Sutures

THERMO-FLEX (*non-boilable*) or Claustro-Thermal (*boilable*) catgut, and black braided silk with half-circle, taper point Atraumatic needles Suture length 28 inches



NO	MATERIAL	SIZE	NEEDLE
1635	Non-Boilable Plain Catgut	0	T-1
1625	Boilable Plain Catgut	0	T-1
1624	Black Braided Silk	000	T-2

Package of 12 tubes of a kind $4 20

Plastic Sutures

FINE sizes of Kal-dermic, silk and silkworm gut with small, cutting point Atraumatic needles Suture length 18 inches Boilable



NO	MATERIAL	SIZE	NEEDLE
1651	Kal-dermic	8-0	B-1
1651	Kal-dermic	6-0	B-1
1652	Kal-dermic	8 0	B-5
1652	Kal-dermic	6-0	B-5
1652	Kal-dermic	4-0	B-5
1653	Black Silkworm	4-0	B-1
1655	Kal-dermic	4-0	B-2
1658	Black Silk	4 0	B-2

Package of 12 tubes of a kind $4 20

Other D & G Sutures

SPECIAL needled sutures are also prepared for dental, tonsil, circumcision, obstetrical, ureteral, renal, nerve, artery, and emergency work These are in addition to our complete line of unneedled sutures embracing catgut, ribbon gut, kangaroo tendons, and a variety of other non-absorbable materials

DISCOUNTS ON QUANTITIES

DAVIS & GECK, INC , 217 DUFFIELD STREET, BROOKLYN, NEW YORK

Copyright 1938 Davis & Geck, Inc Printed in U S A



To do One Thing well

To produce a suture which excels both in physiologic integrity and mechanical refinement calls for technical control, experience, and craftsmanship of a type not easily acquired It is a work which well deserves the full time and attention of an organization created solely for this purpose.

D & G Sutures

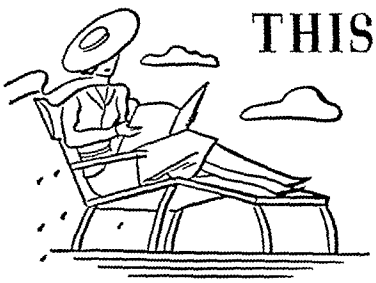
"THIS ONE THING WE DO"

DAVIS & GECK, INC - - BROOKLYN, NEW YORK, U S A

Mix THIS



with some of



THIS,

DOCTOR...

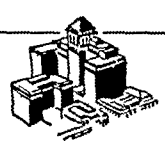
Days in the briny air, by the restful rolling ocean, are a good supplement to any prescription Likewise the conveniences and hospitalities of these great beachfront hotels, with their long Ocean Decks, sunny seaside lounges and rooms, health baths, concerts and countless ways of making a patient feel at ease

Chalfonte-Haddon Hall employs two dietitians for diet patients Excellent food Restricted clientele

LEEDS AND LIPPINCOTT COMPANY

CHALFONTE-HADDON HALL

ATLANTIC CITY

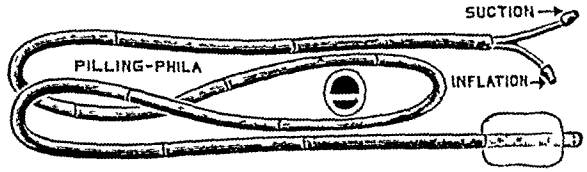


PILLING

MILLER-ABBOTT DOUBLE LUMEN TUBES

FOR SMALL INTESTINAL INTUBATION

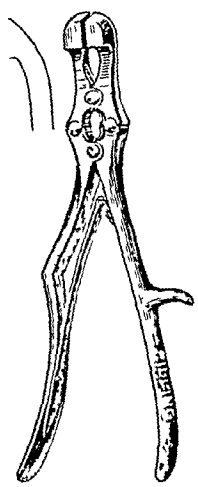
T Grier Miller, M D , and W Osler Abbott, M D



P 9140—Miller-Abbott double lumen tube, Style 11
$7 50

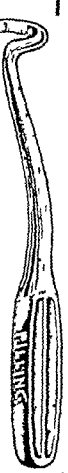
Described in
Surgery, Gynecology and Obstetrics
April, 1938
"Intubation Studies
of the
Human Small Intestine"
by
W. Osler Abbott, M.D.
and
Charles G. Johnston, M D , F.A C S
Circular on request

INSTRUMENTS FOR



THORACOPLASTY
THORASCOPY
PNEUMOLYSIS
PHRENICECTOMY
LOBECTOMY
PNEUMOTHORAX
DECOMPRESSION

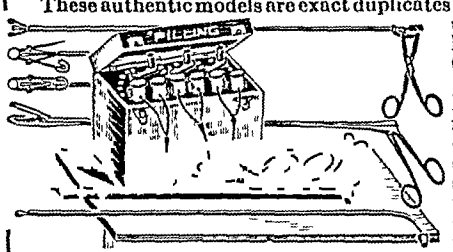
SEND FOR LITERATURE



BRONCHOSCOPY

Pilling-Made Equipment Used by the Staff of the Chevalier Jackson Clinics

These authentic models are exact duplicates of those made by us for and used by the various Chevalier Jackson Clinics in Philadelphia All made under our one roof and supervision insuring proper inter-functioning of separate instruments



Bronchoscopic Catalog on Request

GEORGE P PILLING & SON CO
Arch & 23rd Philadelphia

What DISEASES or CONDITIONS affect the BASAL METABOLIC RATE?

DISEASES of the thyroid gland, nephrosis, obesity, undernutrition, pregnancy, and others

When these diseases or conditions arise, basal metabolism tests are indicated for one or more of the following reasons

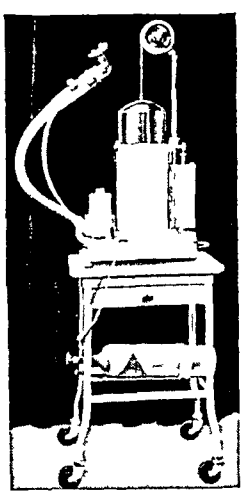
1 To differentiate true thyroid diseases from other disorders which show similar symptoms

2 To see to what level the particular disease has caused the BMR to rise or fall

3 To ascertain the effectiveness of iodin, x-ray or other therapy

4 To determine safe operating risks

Investigate SANBORN MODEL E-I-S



a simplified, modern, low-priced metabolism tester

★

MODEL E-I-S features include

A quiet *electric motor-blower* for automatic circulation of oxygen

A light-weight oxygen bell balanced by a *spring mechanism* which reduces friction

An *inkless writing point* to trace a clear chart record and eliminate the bother of ink pen filling and cleaning

The Sanborn Metabolism Calculator for *simplified rapid* BMR *computations* without written calculations

For further information and details of APPROVAL PRIVILEGE and LOW FACTORY PRICE, return coupon

SANBORN COMPANY
39 Osborn St , Cambridge, Mass

Without obligation please send full details about MODEL E-I S Metabolism Tester

Dr

Street

City State S-4-38

Cook County Graduate School of Medicine

(IN AFFILIATION WITH COOK COUNTY HOSPITAL)
Incorporated not for profit

ANNOUNCES CONTINUOUS COURSES

MEDICINE—Two Weeks Intensive Course starting June 20th Electrocardiography every month Special Courses during August

SURGERY—General Courses One, Two, Three and Six Months Two Weeks Intensive Course in Surgical Technique with practice on living tissue Clinical Course Special Courses Courses start every Monday

GYNECOLOGY—Personal Courses May 2nd June 13th August 22nd Gynecological Pathology by Dr Schiller starting July 25th

OBSTETRICS—Two Weeks' Intensive Course starting June 6th Informal Course starting every week

FRACTURES & TRAUMATIC SURGERY—Informal Course, Intensive Formal Course starting June 6th

UROLOGY—One Month Course Two Weeks' Course starting every two weeks

CYSTOSCOPY—Ten Day Practical Course rotary every two weeks

GENERAL INTENSIVE AND SPECIAL COURSES IN ALL BRANCHES OF MEDICINE, SURGERY AND THE SPECIALTIES EVERY WEEK

TEACHING FACULTY
Attending Staff of Cook County Hospital

Address Registrar 427 South Honore Street
Chicago, Illinois

WANTED

ANNALS OF SURGERY

April, May, June and August, 1937 issues

$1.00 will be paid if in good condition

ANNALS OF SURGERY
227 South 6th Street
PHILADELPHIA, PA



» » EXERCISE « «

Exercise is an important factor in the treatment of constipation Of equal importance are suitable diet and a regular habit time for bowel movement, which under the present mode of living, are often difficult to enforce For the patient who is unable to exercise or adhere to a suitable diet a regular bowel movement may be brought about and maintained with Petrolagar It assists in establishing a regular bowel movement because it mixes intimately with the feces to form a soft, easily passed stool Petrolagar is prepared in five types for choice of medication Petrolagar Laboratories, Inc , Chicago, Illinois

Petrolagar — Liquid petrolatum 65 cc emulsified with 0 4 Gm agar in a menstruum to make 100 cc



Petrolagar



CAL-C-TOSE HITS THE MARK

IN ADULTS as well as in growing children Cal-C-Tose (formerly known as Cal-C-Malt) goes right to the mark in maintaining nutrition and in restoring strength and well-being to those who are depleted by illness or overwork Cal-C-Tose is a tonic food, highly effective in accomplishing these purposes Cal-C-Tose derives its tonic food properties not only from its nutritive elements, but from its generous content of vitamin C, in addition to dicalcium phosphate, vitamin B, and beneficial minerals—all incorporated in the finest quality chocolate base Each dose, 2 teaspoonfuls, contains 50 mg of pure, synthetic cevitamic acid 'Roche,' equivalent to the fresh juice of 2 medium size oranges Cal-C-Tose mixed with milk makes a delicious drink

Cal C Tose is supplied in 12 oz cans and 5 lb family size cans

•

Professional samples to physicians on request



HOFFMANN-LA ROCHE, Inc

Roche Park • Nutley, New Jersey



Physicians are invited to specify Lilly Products on prescriptions because the Lilly trade-mark stands for

1 Pure chemicals and high-grade basic materials

2 The most improved methods of pharmaceutical and biological manufacture

3 A policy of distribution and advertising that seeks to place emphasis on medical care where it belongs—the service of the physician

'Merthiolate' (Sodium Ethyl Mercuri Thiosalicylate, Lilly) meets important surgical requirements Antisepsis of the intact skin, mucous membranes, and exposed soft tissues can be accomplished with minimal cellular damage

Tincture 'Merthiolate' and Solution 'Merthiolate' are supplied in four-ounce and in one-pint bottles

ELI LILLY AND COMPANY
INDIANAPOLIS, INDIANA, U S A

THE STANDARD ANESTHETIC AGENT



IN DISCUSSING various anesthetic agents, Lundy[1] states "Ether has a reputation for dependability which makes it a standard with which other anesthetic agents may be compared I feel certain that, if all general anesthetic agents except one had to be given up, ether would be the one that would be retained "

E R Squibb & Sons are the oldest and largest producers of anesthetic ether They produce one quality of ether only—the best for anesthesia In addition to the great care exercised in its manufacture, Squibb Ether is the only ether packaged in a copper-lined container to definitely prevent the formation of undesirable toxic substances

For over eighty years Squibb Ether has been used by surgeons and anesthetists the world over Today, its use in over 80% of American hospitals, and in millions of cases every year, is evidence of the satisfaction which attends its use

[1] Lundy J S Inhalation Anesthesia, *Med Record & Annals of Houston, Texas,* 30 723 (May) 1936

For descriptive literature write Anesthetic Division E R Squibb & Sons, 745 Fifth Avenue, New York

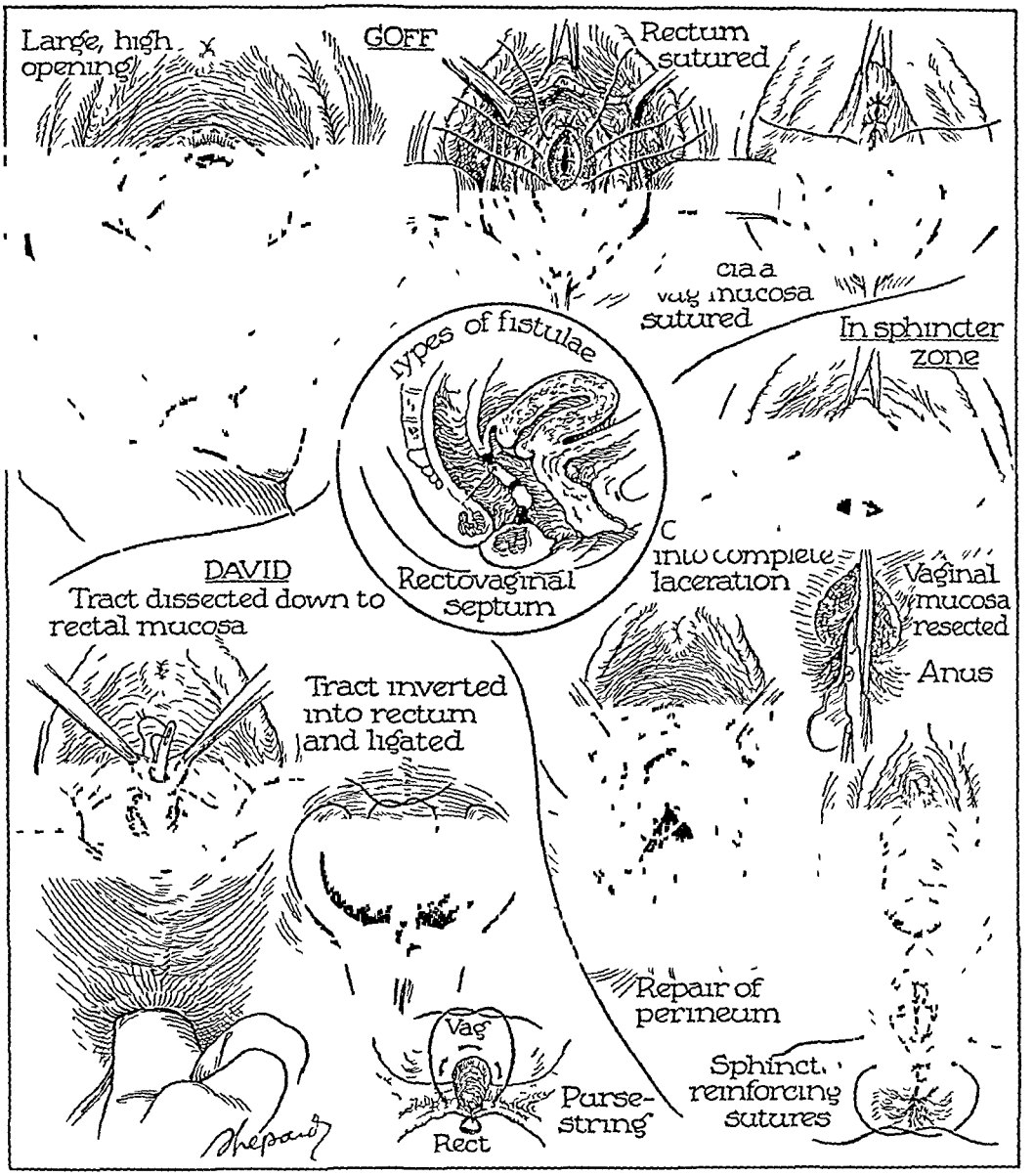


SQUIBB ETHER

OPERATIVE PROCEDURE

PLATE NO 81

Treatment of Rectovaginal Fistula



Tests in live tissue are a vital part of the search for ever better and better formulae for surgical suture production, carried on constantly in the Johnson & Johnson Laboratories Hundreds of animal implants are made yearly, and complete case histories kept, by our own scientists to develop methods to serve the increasingly rigid demands of the surgical profession The quest for greater adaptability and uniformity is unceasing

ETHICON NON-BOILABLE CATGUT SUTURES

JOHNSON & JOHNSON, NEW BRUNSWICK, N J , CHICAGO, ILL

MANUFACTURERS OF SURGICAL SUTURES SINCE 1887

Lukens Sterile Catgut

TRADE (Bartlett Process) MARK



Make the Test Yourself

Compare It Point for Point With any Other Catgut

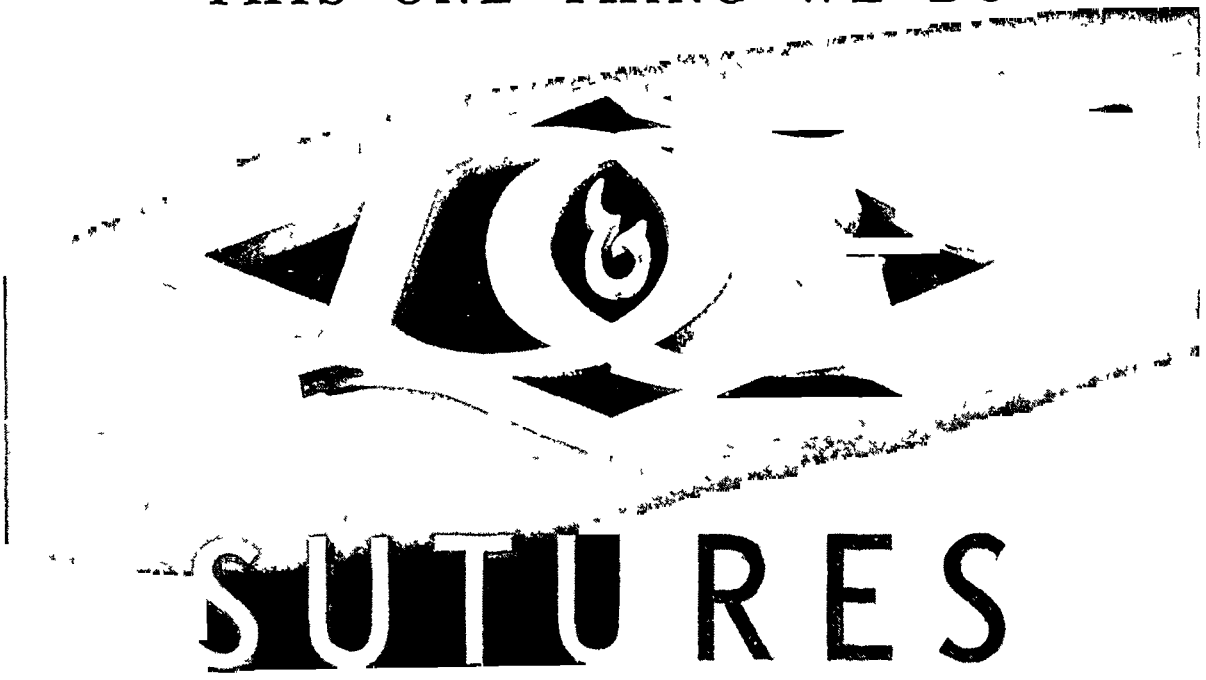
We Will Send the Samples

Sizes 00-4 Plain

C. DE WITT LUKENS CO.
4908 Laclede Ave.
ST. LOUIS, MO., U.S.A.

Sizes 00-4 Tanned

"THIS ONE THING WE DO"



SUTURES

DAVIS & GECK, Inc Brooklyn N Y

ANNALS OF SURGERY

VOL 107 MAY, 1938 No 5

TRANSACTIONS
OF THE
SOUTHERN SURGICAL ASSOCIATION

MEETING HELD AT BIRMINGHAM, ALA
December 7, 8, 9, 1937

INTRODUCTORY ADDRESS

BY THE TOASTMASTER

IRVIN ABELL, M D

LOUISVILLE, KY

THE Southern Surgical Association returns this year to its natal city, and we, who enjoy the privilege of being the professional descendants of the worthies who founded it, come together to pay a tribute of respect and honor to those who launched upon the professional sea, an association that was destined to attain a position as one of the foremost surgical bodies of the world With its geographic boundaries limited to the Southland, it offered to the devotees of surgery and gynecology of this section an outlet for their productions, many of which have found an enduring place in the fields of surgical literature and of surgical attainment At the time of its founding the advantage and opportunities offered by the societies and literature of today were but in their infancy and the Southern Surgical and Gynecological Association afforded for many the one portal for their entry into the field of professional letters

In his address of welcome delivered at the first Annual Session in Birmingham on December 4, 1888, the Hon A O Lane, Mayor of the City, aptly expressed in the following words one of the prime reasons for its existence "There is no thinker so profound but that he can reach a greater depth through the stimulus of other minds, there is no genius so luminous but that it can gather new radiance by borrowing new gems of thought And I know of no better means of communicating thought and securing concerted action than for the thinkers and actors to come in close personal con-

tact and communion The most attentive reader will turn from a printed lecture, which he can buy for a nickel, and pay a dollar to hear it spoken by the author, and consider the investment wisely made In the first case he sees, but in the second he sees, hears, and feels, and living for the time being with the author he grasps his thoughts, and receives the impress of his mind"

In his presidential address delivered at the same meeting Dr W D Haggard, Sr, in speaking of the new Association, said "Its face is set in the right direction, with its eyes fixed upon the rising and not the setting sun It forms a nucleus around which the votaries of science may gather, and as the great republic of letters forms the democracy of science whose realms are penetrated by no royal road, it is open on all sides alike to those who with persistent industry, energy and skill, shall ask to join the grand army of scientific observers So we reach out our hands and invite into our circle such men as have by their works entitled them to the distinction of being educated, talented and industrious workers in the field of scientific research"

The first volume of Transactions published following the Birmingham meeting, in 1888, shows upon the membership roster the names of 97 distinguished practitioners, all hailing from the Southern States The membership limit was later set at 150 and surgeons of distinction from regions of the country other than the Southland were admitted to Fellowship At the 29th Annual Meeting held at White Sulphur, Va, in 1916, the name of the organization was changed from the Southern Surgical and Gynecological Association to the Southern Surgical Association Still later when the increase in population and the growth and development of surgery and its specialties produced an increasing number of surgeons of ability meeting the requirements for membership, the limit was raised to 200, at which it now stands Beginning, as Doctor Haggard, Sr, stated, with its eyes fixed upon the rising sun, the Association has consistently maintained this attitude, its record during the 50 years showing a progressive march of enduring achievement In the list of its presidents are to be found the names of many who not only graced the Southern Surgical Association but as well shed luster upon American medicine W D Haggard, Senior and Junior, Hunter H and Stuart McGuire, Lewis S McMurtry, Louis McLane Tiffany, Richard Douglas, W E B Davis, Howard A Kelly, F W Parham, Rudolph Matas, J M T Finney, Thomas S Cullen, James E Thompson, Randolph Winslow, C Jeff Miller, H A Royster and Guy L Hunner, all loom large on the horizon of American surgery, on the milestones of which will be found an enrollment of their accomplishments Each and every one whom the Association has honored with its presidency, with the exception of the incumbent in 1925, has left his imprint on the scroll of time, in attestation of the offerings of Southern surgery reverently placed upon the altar of science

The volumes of Transactions represent the ever advancing wedge of current surgical knowledge for their respective periods, containing the records of priority achievements and contributions from clinical research that have added materially to the sum total of surgical lore The responsibility for the

acquisition and the dissemination of medical learning rests solely on the profession Its greatest asset is constituted by the constantly accumulating fund of knowledge stored in the minds and in the literature of its members In reviewing the history of this Association one finds abundant evidence that its members have discharged with everlasting credit their obligation in contributing to the surgical portion of this common capital

The Southern Surgical Association, collectively, has always measured up to the traditions and heritage of American medicine, which in part may be briefly summarized as follows "Medicine is a most active profession, always filled with new and striking problems, and one of the best since its aim is the betterment of man Medicine is the most ancient of professions, being older than Christianity and antedating the inception of civil law It has its own system of rewards and punishments, its own disappointments and its own glories It is a profession that has a broadening influence on the human mind and is characterized by a most splendid charity It is an acquisition in the best tendencies and a protection against the worst tendencies It constructs no trusts, it founds no monopolies, it excludes no qualified practitioner, it retains for its profit no valuable discovery and it has no standing room for the quack, the scoundrel and the charlatan Its best work is done in the light which beats upon its throne, not in the arena of politics encouraged by the cheers of thousands, not in the seclusion of the cloister sustained by the hope of eternal joy, but in the storm and wind swept country, in the streets of the village, in the boulevards of the city, on the desolate field of battle where pain and pestilence, illness and misery are combated often with none but God to see it It furnishes a curiously checkered life, a life in which storm clouds alternate with sunbeams With the exception of the ministry it stands closer than any other calling to the secret of eternity and watches death ever busy with her shuttle as she weaves her somber threads into the woof and warp of the affairs of men It seeks to mitigate human sufferings, to prolong human life" These have ever been its watchwords, are still and always will be, constituting its cloud of smoke by day and its pillar of fire by night "One should enter such a profession with properly exalted ideals, with a belief in its greatness, its dignity, its stability, its real importance, its essential strength One should resolve to learn to observe, to compare, to analyze, to study, to think, to avoid formulas, to cast out sordid thoughts, to repudiate shallowness, advertising and vain pretensions" In short, to be a worthy disciple of Æsculapius, reflecting honor and credit on the profession and deriving from it the happiness that makes life worth while, being held in grateful remembrance by those whom one has served and in respect and esteem by the confreres with whom and among whom one has lived and worked It becomes now my pleasing duty to present to you another distinguished president, whose contributions to the common store of surgical knowledge have been most signal ones—our president, Dr Fred L Rankin

PRESIDENTIAL ADDRESS

MILESTONES ON THE ROAD OF SURGERY*

FRED W RANKIN, M D
LEXINGTON, KY

TO-DAY marks the semicentennial of the founding of the Southern Surgical Association It is a day of remembrance Fifty years ago in this City of Birmingham, leading surgeons of the South met to organize an association destined to become one of the outstanding factors in surgery of the Western Hemisphere Since its organization a generation has died—a group of successors has been born upon whose shoulders has fallen the mantle of membership in this favored assembly

The roster of the battalion of pioneers no longer holds the name of a single Founder on its list of the living, the last of the old guard, Dr Isaac Scott Stone, answered the final rollcall in December, 1936 Through this half century the Southern Surgical Association has recorded in the deeds of its Founders and members a monument of service to science worthy of the men who, in November, 1886, met to discuss the formation of a society to be known as the Alabama Surgical and Gynecological Association This meeting was held at the invitation of Dr W E D Davis and his brother, Dr J D S Davis, editors of the Alabama Surgical and Medical Journal, of Birmingham

Realizing the difficulties which would be placed in the way of the infant union, should it come in conflict with the medical association of the State of Alabama, it was emphasized that its work was scientific and entirely unrelated to other medical matters Its object was only the advancement of surgery and gynecology in the State of Alabama

At this meeting a dozen of the leading surgeons of the South were made honorary members designing, as Doctor W E D Davis said "To form a Southern organization later with these distinguished men as a nucleus" Doctor Davis in his Presidential Address, in 1902, again insists that he had the idea of a wide sectional surgical body, but deemed it more advisable to develop the local Alabama society immediately and to put off until some future time expansion into a larger and more exclusive body "The early extension of the Alabama Society," he says, "into the Southern Surgical and Gynecological Association, was due entirely to Jerome Cochran of Alabama" A great medical organizer, Cochran displayed a lack of interest in, perhaps not a hostility toward, the new organization, but certainly began to discourage its support by the foremost men of the local profession Not only did he

* Delivered before the Southern Surgical Association, at Birmingham, Ala, December 7, 1937

fail in sympathy with the president, Doctor Rossei, but was suspicious of the editors of the Alabama Medical and Surgical Journal because they differed with him on some points connected with the state association As a result of this lack of sympathy the leaders of the Alabama Association decided to enlarge its scope and during the meeting of October 11–12, 1887, the Southern Surgical and Gynecological Association was formed, mainly by men from Alabama but with a few notable outsiders such as Haggard and Cain of Nashville, and Hyer, of Mississippi It may be said that after the formative years of the association had passed, Jerome Cochran became a firm supporter of the association and a friend of its Founders

The organization was perfected October 12, 1887, with Dr W D Haggard, Sr, President, and Dr W E D Davis, Secretary These forward-looking men, with a profound disregard of that superb individualism and magnificent provincialism which was so much a part of the old South and which Southerners of this generation so love and revere, realizing that science knows no bounds, disregarded geographic considerations and soon instituted the policy of inviting prominent surgeons of other sections of the country to become members

In the Constitution adopted at this meeting, Article 2 states "The object of this Association is to forward the study and practice of surgery and gynecology among the profession of the Southern states" Article 2 of the present Constitution reads "The object of this Association shall be to further the practice of surgery in the various departments, especially among the profession of the Southern states" A slight change indeed, from the original Article 2, but indicating that the objectives of the Association have always been those of men of pioneering instinct, namely, disregard of territorial boundaries

Any surgical organization founded in the South has indeed a rich heritage The names of Crawford W Long, Ephraim McDowell, J Marion Sims, Brasheer, McCreary, Smythe, Eve, Benjamin Dudley, Winslow, Yandell, Battey, Bedford Brown, McGuire, Kallock, Haggard, Sr, Samuel D Gross, Tiffany, Stone, Richardson, Briggs, Gorgas, McMurtry, Campbell, Westmoreland, Gilmore, Mott, Mastin, and a long roster of other celebrities worthy to be classed with these immortals, are shining lights of a former generation in the starry firmament of Southern surgery

Steeped in the traditions of the past, there has been transmitted to us of this generation a sacred trust as members of the Southern Surgical Association Tradition is the oral record of successful actions and deeds of the past, which, transmitted to a succeeding generation, influences its achievements because of loyalty and reverence for the past Facts stand the test of time—opinions die and are forgotten "Time," writes the scientist, "overthrows the illusions of opinion but confirms the decisions of nature"

The traditions of this Association as handed down from its Founders remain unchanged Born at the beginning of a new era when Lister and Pasteur had revolutionized the practice of medicine and surgery by their dis-

coveries and transformed it into "an art of limitless achievements and applications," the Fathers of the Southern Surgical Association were not, as Maes so aptly puts it, "confused that they had made pure science its chief aim—they saw more clearly, alas, than many of us today, wherein lie the true medical values 'They recognized with equal clarity that the ultimate aim of the surgical art is not the exhibition of scientific principles, but the healing of the sick Their emphasis upon the art rather than upon the science of surgery colors their communications, permeates their discussion, is implicit in their every pronouncements'" Still loyal to these aims, ideals, and traditions, this Association represents the highest, not only in scientific surgery, but in its clinical application, and still considers the healing of the sick to be the paramount office of surgeons, a justifiable obligation of a craft as old as man himself and born of trauma, by necessity The pages of history chronicle its development both as an art and a science from remotest antiquity, in stages sometimes empirical, frequently beclouded by argument, but always going forward with an idealism which has become a characteristic of our profession

While the surgical shrine of the future will in all probability have many and varied pillars representing conditions of which we of the present generation have little conception, the temple of the past rests firmly upon a foundation of anatomy, supplemented and reinforced by physiology, buttressed by research, and fortified within the past century by the other ancillary sciences of pathology, bacteriology and biochemistry

Anatomy is the cornerstone of the foundation upon which the edifice of medicine has been built and has from earliest times been the vital groundwork of the art and science of surgery as evidenced by the fact that throughout the ages the master surgeons have been anatomists first and surgeons second As priceless ingredients in the binding mortar of its structure, there have appeared the names of such pioneers as Vesalius, perhaps the greatest of all anatomists, Fabricius, Morgagni, and others, leaving their impress on future generations

Five centuries after Hippocrates had established medicine as a science and the school of Alexandria had succeeded in confirming anatomy in its relationship to medicine in general by carrying out the first dissection of the human body, Galen came to Rome and introduced the science of research Avicenna, born in 980 A D, was responsible for carrying the work of Hippocrates and Galen into the East and thence to Europe by means of the Arabs

Following Galen for a period of years, perhaps covering many centuries, the medical profession entered into an era of empiricism and philosophic disputation from which it was revived by the work of such pioneers as Pare, "Prelate of French Surgeons", Wiseman, "Father of English Surgery", Harvey, with his discovery of the circulation of the blood, John Hunter, "the greatest surgeon of all ages before Lister", Lister, Long, and others who by their dauntless and untiring efforts succeeded in leading the science of surgery along a darkened path occasionally made brilliant by the results of their own perseverance and genius

The story of surgery actually becomes the story of accident and trauma of a life brought in constant contact with the claws and fangs of wild animals and the crushing weapons of an almost equally wild human race With the wiping out of earlier civilization under the repeated invasions of the Huns, Vandals, and the Nordic hordes, surgery with the other arts and sciences fell upon dark days, not to be revived until some 800 years after the fall of Rome, when medieval surgery was born

"The quarrel as to whether medicine is a science or an art has not subsided," said Lord Moynihan, "and will not be silenced until it is recognized that medicine is fully entitled to rank with both, with science in its enquiry, with art in its practice" It is a profession whose disciples deal in the Mosaic of life not only with processes of disease, but with the patient likewise The practice of surgery, as Learmonth so aptly puts it, "combines the flawless union of surgical craft and surgical art" Science represents the accumulation of knowledge, which knowledge applied to clinical surgery is surgical judgment, an intangible thing which Cushing refers to as "a more or less inspirational quality which is variable and elusive, all surgeons being conscious of having it in hand on some occasions, of losing it on others It is a good deal like a game which even the best and most consistent player foozles for some unaccountable reason at certain times"

The art of surgery deals largely with handicraftsmanship It is the application of knowledge toward a definite objective, and while in this manner it parallels the science of surgery, actually it is the application of facts which have been gleaned from science Repeated application of knowledge develops skill and deftness It has been said that knowledge represents the scars of experience, healed wounds too often received through disappointment and discouragement, almost to the point of despair The unblemished union of the idea and execution of a surgical maneuver is the perfection of art Artistic handicraftsmanship is the result of accuracy, gentleness, timing and decision, speed is not an essential factor in the performance of an operation A prolonged operation, under proper anesthesia and carried out with gentle manipulation of the viscera and tissues under attack, may be accomplished without detriment to the physiologic equilibrium The quickly accomplished operation, indeed, may be a most badly performed one and the so-called speedy and dextrous operator may be a dangerous surgeon Boldness and daring in the operating room may not be substituted for judgment, but the uncalloused and responsive surgical conscience plus vision and experience constitute the mature surgical soul

Timing is but the rhythmic coordination of energy applied in a given direction, the one element of time which makes for speed with accuracy is the elimination of false motions To this add the careful placing of ligatures, the accurate isolation of planes of tissue and skillful resection of viscera containing pathologic elements, the gentle coaptation of anatomic layers of suture, and all done with reverence for the parts, a surgical operation becomes comparable to the work of the great artists When an operative maneuver

has been carried out in this manner to its consummation, the evidence of the maturity of the operator is again reflected in his ability to recognize the end rather than to continue fondling tissues and organs with evident reluctance to abandon his task

Artists build from inert material displaying on canvas or in marble the anatomic outlines of the human form in its purest perfection, but the surgeon uses the body of his fellowman for his canvas The responsibilities of a surgical operation should, and do rest heavily upon the conscience of a Master Surgeon To perform a delicate operation upon the human body should be a ritual, and when appreciated in its beauty, is the ultimate in art To observe the masterly deftness and accurate craftsmanship of a Cushing, a Crile, or a Finney, gives one the feeling that this epitome of the accomplishment of the surgical act is being carried out like Michelangelo, Leonardo Da Vinci, or Benvenuto Cellini accomplished their immortality in art

The performance of the operative act rests upon three columns in the surgical temple—hemostasis, anesthesia, and asepsis Hemostasis was the first of these fundamentals developed by man and represents the first constructive act in the treatment of trauma Accomplished first by pressure, subsequently by tourniquet and hot irons, the ligature finally was evolved Celsus mentioned the ligature but not the application of it

The circulation of the blood through the body remained, through the ages, shrouded in mystery until Harvey, in 1620, described it Galen first described the arteries as carriers of blood but failed to uncover many anatomic facts because of his disposition to hide science behind a screen of theory regarding the spirits of the body Attributing bodily functions to the agency of these spirits, research was abandoned and nothing definite and clear-cut resulted The application then of constricting materials to vessels arresting hemorrhage, remained to that high priest of French surgery, Pare, in the treatment of wounds at the Battle of Dam Vielliere, in 1552

Secondary hemorrhage due to infection remained the *bete noire* of surgeons and even to-day is a feared postoperative complication, but much less common of occurrence than in prelisterian times Only since anesthesia has permitted one to work carefully, accurately, slowly, and with great attention to detail and tissues, has proper hemostasis been possible Halsted, perhaps more than any other man of modern times, is responsible for the careful and accurate clamping of arteries with small artery forceps and without injury to the adjacent tissues, and ligating them accurately and singly Called by Cutler "the author of the surgery of safety," he demonstrated that the time element in surgery is not of maximum importance, but an operation may be a careful, leisurely procedure if carried out with the utmost respect to tissues

The second fundamental of surgery—namely, anesthesia—discovered in 1842, made possible the abatement of the operative horrors common to the earlier centuries The administration of an anesthetic is a part of the surgical art which is still, I feel, not completely appreciated To recognize its value requires long experience and intensive study by one interested in this phase of

operations and not by one who uses it as a stepping stone With proper anesthesia, and consequently good relaxation, surgical operations are performed with less risk and fewer complications as well as inconveniences to the patient

Many advantages are gained by preanesthetic medication which tends to reduce the fear and dread of operation to a minimum, and is greatly appreciated by both the patient and the surgeon That the ideal anesthetic has not been discovered yet is undoubtedly true, but that hope of its appearance need not be abandoned may be asserted with equal confidence

Asepsis, the most important but last discovered of the triad of contributory principles upon which surgery is based, announced by Lister 20 years after the discovery of anesthesia, established surgery as a science and made possible the accurate application of the surgical art to every cavity and location in the body

The momentous discoveries of Pasteur caused the greatest revolution ever recorded in medical history, albeit his countrymen denied them Lister first applied these principles to suppurating wounds Lord Moynihan accorded him a glowing tribute when he said "He has been the cause of saving more lives than all the wars of the ages have taken away"

Asepsis begins with the preliminary maneuvers prior to operation and includes not only the sterilization of instruments, appliances, and dressings to be used in the operative field, but the surgical cleanliness of the operator himself, and his entire corps of assistants The control of sepsis, called to-day "surgical technic," leaves an operation no longer an adventure among microorganisms, and the responsibility of its thoroughness should rest heavily upon the conscience of the entire operating room personnel The words of Hippocrates "The things relating to surgery are—the patient, the operator, the assistants, the instruments, the light, where and how, how many things, and how, where the body, and the instruments, the time, the manner, the part"—accurately emphasize all the important factors which, taken together, comprise a surgical picture

A handmaiden of the surgical triad and one of the most important factors in the successful carrying out of any operation is exposure More operations are badly performed because of inadequate exposure secondary to small incisions or a poorly isolated operative field than because of almost any other factor

Many complications such as hemorrhage, injury to bile ducts, recurrent laryngeal nerves, or ureters occur because the exposure is too incomplete to permit an anatomic dissection of the vital organs in the operative field Retracting the tissues gently and exposing the pathology in question is not only one of the most important functions of some member of the operating team, but is an art in itself and an act upon which every busy surgeon should insist The proper position on the table, the proper placing and the extent of the incision, and retraction without trauma to the tissues not only make the difference between an artistically and rightly performed operation and one

accomplished clumsily and with difficulty, but in these proper steps are guaranteed freedom from complications, as well as better wound healing and ultimate recovery With the improved technic of modern surgical operations, accomplished by dextrous hands, this generation has seen a most extraordinary reduction in operative mortality, a very great increase in the comfort of the patient both before and after operation, and greater satisfaction in the ultimate outcome

The aims of present-day surgery which should be, and reasonably are, laudable attempts to justify the glorious tradition of our guild, and the disposition to accept the responsibilities which our illustrious predecessors have imposed upon us are indicated in our modern practice by certain trends which inevitably affect the currents of our progress In an hour of social, economic, and political unrest, it is comforting to reflect that our generation takes up but a small limit of time in its relation to the future, and that probably "the new energizing racial spirit whose resulting momentum of events will carry us farther and faster in a few years than in any generation past" will hardly cause scientific progress to deviate from its normal cycle, although one must recognize the present-day ferment

The three major objectives which I believe the progress of modern surgery will demand in the future are First, elevation of standards of graduate instruction, second, adequate certification of surgeons, and third, the controlled hospital

Increasing specialization naturally evokes a number of questions Do we have too many specialists, is specialization being gradually overdone? The answer to this, I think, must essentially be—no, we do not have too many qualified specialists—that is, if we designate as a specialist a member of the profession who by training and experience will be accepted by his peers as expert in a particular field

There is no substitute for experience and only by prolonged apprenticeship in a given field may anyone become sufficiently qualified to be designated as a specialist The requirements to-day set up to establish adequate qualification and certification of specialists are evidence of forward-looking rather than a *laissez-faire* attitude, and undoubtedly will result in surgical achievement consonant with the traditions of the past

The great trend toward specialization is unquestionably the most important single change in medicine during the last quarter century—a change brought about, one is convinced, both by the medical profession itself and by the attitude of the laity toward specialists Indeed, specialists have developed until the practice of surgery has become the art of specialization, and who among surgeons would have it otherwise? No longer is the statement true of the great Gross that "It is safe to say that there is not a medical man on this continent who devotes himself exclusively to the practice of surgery, and that American medical men are general practitioners and cover the entire field of medicine, surgery, and obstetrics"

So different are conditions nowadays, and so divided is medicine that

surgery itself is subdivided into multiple specialties Information accepted both by the Committee on the Cost of Medical Care and the Commission on Medical Education points out that from 24 to 39 per cent, or an average of one out of three physicians in the United States, to-day limits himself to a specialty in some field The general surgeon of to-day lives in the afternoon of his career His immediate future is clearly outlined and directed by the changes which medical education is undergoing

Due in a large part to the efforts of the Council on Medical Education and Hospitals of the American Medical Association, since the turn of the present century undergraduate educational standards have been improved, substandard schools eliminated, hospital standards elevated and by and large it may be said that the candidate for the M D degree receives a satisfactory and uniform education, with a flexible curriculum, adaptable enough to meet the changing demands Once graduated, however, the picture is an entirely different one and as Pool pointed out in his masterly Presidential Address before the American Surgical Association in 1936 "The weakest link in the chain of medical education is in postgraduate surgery"

To meet the increasing demands for providing trained specialists, a definite movement is under way throughout the medical profession, fostered and forwarded by authoritative organizations, not only to arrive at and fix standards of training for postgraduate education, but to increase the opportunities for training surgeons by the utilization of all the hospital and teaching facilities which are available There are now 12 Specialty Boards functioning and focusing attention on the necessity of elevation of standards beyond those which now exist, as well as providing methods and means for so doing

The most recent of these boards, the American Board of Surgery, is concerned with the principles of postgraduate study and has established definite qualifying standards of training and apprenticeship which are a conservative medium in a sea of complex opinions relative to the length of time and training necessary to qualify surgeons in a given field Five years of training after the intern-year, three of which are devoted to intensive postgraduate study before the candidate is eligible to take the examination, is the middle course adopted by this Board Certainly, it must be agreed that graduate training, moral and ethical standards, knowledge of basic sciences, postgraduate study of an adequate, though still undetermined number of years, and apprenticeship under a senior surgeon who is qualified for the practice of surgery will be greatly to the advantage of the group willing to voluntarily undergo this rigorous training It is possible that the stress put on formal and approved apprenticeship needs neither emphasis nor explanation, but it is well to remember that valuable experience does not consist in the unsupervised and uncorrected doing of the same thing in the wrong way a thousand times

That the certification must be voluntary is obvious and the corollary problem, of finding means whereby it is possible for the public to distinguish between the adequately prepared specialist and the one who by self-election

designates himself as such, is closely related to the problem of special licensure and the controlled hospital staff While special licensure for surgeons may be an ideal at which to aim in the future, the complexity of the problem at the present time makes it appear an Utopian dream, and it seems to me that voluntary certification and suasion of a flexible type probably will accomplish much more in the immediate future than attempts to arbitrarily force a change in the present methods

Granted an adequate number of properly qualified surgeons, properly certificated, there remains the problem of providing criteria by which the public may know who is a qualified surgeon This responsibility must be faced and accepted both by the medical profession itself and by the hospitals

The responsibility of the medical profession is to determine standards of proficiency by which surgeons may be judged, the responsibility of the hospital is to enforce these standards rigorously and without fear or favor and at the same time to associate themselves with movements which provide more adequate opportunities for training surgeons in the future Qualified surgeons only, should be permitted to fill hospital staff appointments, and the corollary follows plainly, that only surgeons qualified or in a supervised process of being qualified, for staff appointments should be permitted the privileges of the operating room

Despite the apparent difficulties faced by aspiring young surgeons in the harsh weeding-out process which they are compelled to undergo, they may view with complacency the compensation which the future holds for them There will continue to be progress in surgery Each generation "through its elder statesmen" has invariably been accustomed to feel that with its accomplishments ended, the ultimate has been attained Such an attitude is as old as history itself From Ambroise Pare, in the sixteenth century, through Velpeau and others, down to the late Lord Moynihan, such characteristic utterances have been recorded, and, strangely enough, after each declaration some great discovery along the path of progress in surgery has been announced

To realize that there are still worlds for the surgeon, physiologist, and biochemist to conquer, one need only to recall that cancer, arterial hypertension and many other diseases continue to take their accustomed toll of humanity Opportunity is not wanting, work is yet to be done, forward-looking surgeons may be denied nothing of achievement The old institutions shall not be jettisoned but the structure of surgical science of the future will continue to stand as Bodenhaver wrote "Like the Doric column, simple, pure, and majestic, having Fact for its basis, Induction for its pillar, and Truth alone for its capital"

The heritage of surgery from Hippocrates and Galen through Avicenna, Pare, Harvey, Lister, Long, Pasteur and other immortals, has established markers in the theater of science to be worthy of which we strive Is it not possible, indeed probable, that the surgeon of the future with his background of a noble past, and now more culturally educated, will be found to be a

man of moral assembly whose spiritual values will dominate his every act? Certainly, above all, he must be qualified to practice the art as well as the science of surgery, and possess, as Harvey Cushing says "Both head and heart as well as hand" He will have had a thorough grounding in all premedical and clinical branches, and I suspect that he will find the growing fields of biochemistry and endocrinology entering much more actively into his daily problems than we can visualize at present His postgraduate training will have included from five to seven years of carefully supervised apprenticeship, first in the fields of the clinical branches, and later in his chosen specialty Finally, he will have satisfied an authoritative examining body as to his character, training, knowledge, and technical ability, and let us hope will have added to his litany the prayer "Make me to recognize my limitations" Then will he meet the century-old definition of Valentine Mott "We regard those as surgeons and those alone, who have by conscientious devotion to the study of our science and daily habitual discharge of its multifarious duties acquired that knowledge which renders the mind of the practitioner serene, his judgment sound, and his hand skillful while it holds out to the patient rational hopes for amended health and prolonged life"

INTRACRANIAL ANEURYSM OF THE INTERNAL CAROTID ARTERY

CURED BY OPERATION

WALTER E DANDY, M D

BALTIMORE, MD

Case Report—A rather frail, small, sallow man, age 43, applied at the Johns Hopkins Dispensary February 16, 1937, because of complete paralysis in the distribution of the right oculomotor (third) nerve The family history was negative His general health was good until last year when his stomach "went bad" from drinking He was hospitalized from July to September, 1936, for this gastric disorder which was pronounced "ulcer" He has been a very heavy drinker for the past 18 months

Present History—Six days ago he was awakened by a severe pain in the right frontal region During the afternoon there was a very severe shooting pain in the right eye, but it lasted only a moment He slept poorly that night because of the pain On the following morning diplopia was first noted and in the evening the right eyelid drooped The eye was completely closed the next morning The pain became less severe but two days later became greatly intensified and prevented his sleeping Since then the pain has been present but less severe Examination at that time showed a complete paralysis of the right, third cranial nerve (Fig 1) There were no other positive findings The eyegrounds, visual fields and reflexes were normal A diagnosis of aneurysm along the circle of Willis was made A roentgenologic examination of the head revealed no abnormality The patient returned to the dispensary from time to time until March 19, 1937—nearly five weeks after the onset of his trouble—when Dr Frank Ford referred him to me with the thought that a surgical effort might be worth while There had been no improvement in the local condition in the interim

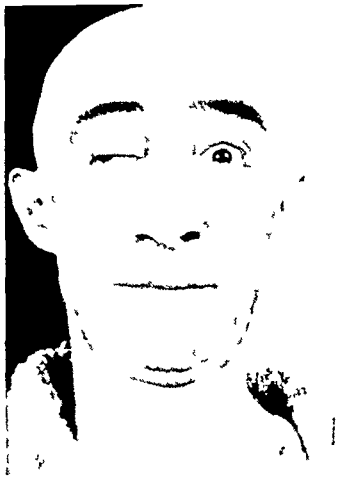


FIG 1—Photograph of patient taken before operation Note the ptosis on the right and the extreme pull of the eyeball outward due to paralysis of the 3rd nerve

The following findings were reported by Dr Frank Walsh, of the Ophthalmological Department, March 12, 1937

"The upper lid is completely closed and can only be moved slightly by the frontalis muscle (Fig 1) The globe is abducted to 45° and only moves laterally and slightly down when it rotates inward (Fig 1) The pupil is 4½ Mm in diameter and one-fourth larger than the left It reacts slightly to light, directly and consensually Visual acuity 20/40 right and 20/25 left Visual fields normal Fourth and sixth nerves are functioning" The Wassermann reaction was negative

Operation—March 23, 1937 A small hypophyseal approach was made on the right side, using the concealed incision There was marked cortical atrophy, evidenced by the pools of fluid in the subarachnoid spaces (doubtless the result of his heavy drinking) The removal of this fluid and that from the cisterna chiasmatis gave ample room for exposure of the chiasmal region upon retraction of the frontal and temporal lobes A pea-sized aneurysm projected from the outer wall of the internal carotid artery and adjacent to the entry of the posterior communicating artery (Fig 4) The aneurysm, however, did not involve this vessel, but arose from the internal carotid by a narrow neck

beyond which it expanded to the size of a pea, therefore, it was quite a small aneurysm Laterally it bridged the adjacent cerebral space and firmly attached itself to the free border of the dura which projects mesially from the middle cranial fossa, it spread out beneath the dura forming quite a broad attachment At this site the covering of the aneurysm changed from the normal grayish-white, shiny covering, similar to that of the carotid artery, to a deep red color Moreover, the surface was irregular, three or four tiny nodules projecting along the margin of the cavernous sinus This change represented the false aneurysmal sac resulting from rupture of the aneurysmal sac The third nerve passed obliquely backward in its normal course and was attached to the aneurysm at only one point—where it entered the cavernous sinus Since it was quite evident that the red color of the aneurysmal wall indicated a reduction in its thickness, no attempt was made to dissect the attachment to the wall of the cavernous sinus There was no evidence



FIG 2.—Photograph of patient taken 13 days after the operation, showing almost complete disappearance of the ptosis, and improvement in the abduction of the eyeball



FIG 3.—Photograph of patient taken seven months after the operation, showing complete return of all functions referable to the 3rd nerve

of subarachnoid bleeding, doubtless the growth into the wall of the cavernous sinus prevented this Forceps placed upon the thick aneurysmal wall pulsated forcibly

The small neck of the aneurysm afforded an easy surgical attack An ordinary flat silver clip was placed over the neck of the sac and tightly compressed, obliterating it completely (Fig 4) The clip was flush with the wall of the carotid artery (Figs 5 and 6) The sac, lateral to the silver clip, was then picked up with the forceps and thrombosed by the electrocautery It shriveled to a thin shred of tissue It is worthy of note that the aneurysm became much softer after the silver clip had been applied, it also ceased to pulsate

Postoperative Course.—Aside from an attack of delirium tremens which lasted three days, patient made an uneventful recovery and left the hospital April 5, 1937—two weeks after the operation At that time there was a definite improvement in the function of the extra-ocular muscles (Fig 2)

On April 8, 1937 (three days later), Doctor Walsh reports (1) Improvement in the ptosis, (2) slight upward movement, and (3) the lateral movements of the eyeball are close to normal The pupillary reaction is still a little less than the left Seven months later there was complete return of all functions referable to the third nerve (Fig 3)

Perhaps ten years ago I saw, with Dr Fuller Albright, an aneurysm situated in a somewhat similar position, localized because of the paralysis of the third nerve and pain in the eye An attempt was made to cure it by ligation of the internal carotid artery in the neck, but the patient died of cerebral softening as a result, probably from an extending thrombus Such an indirect

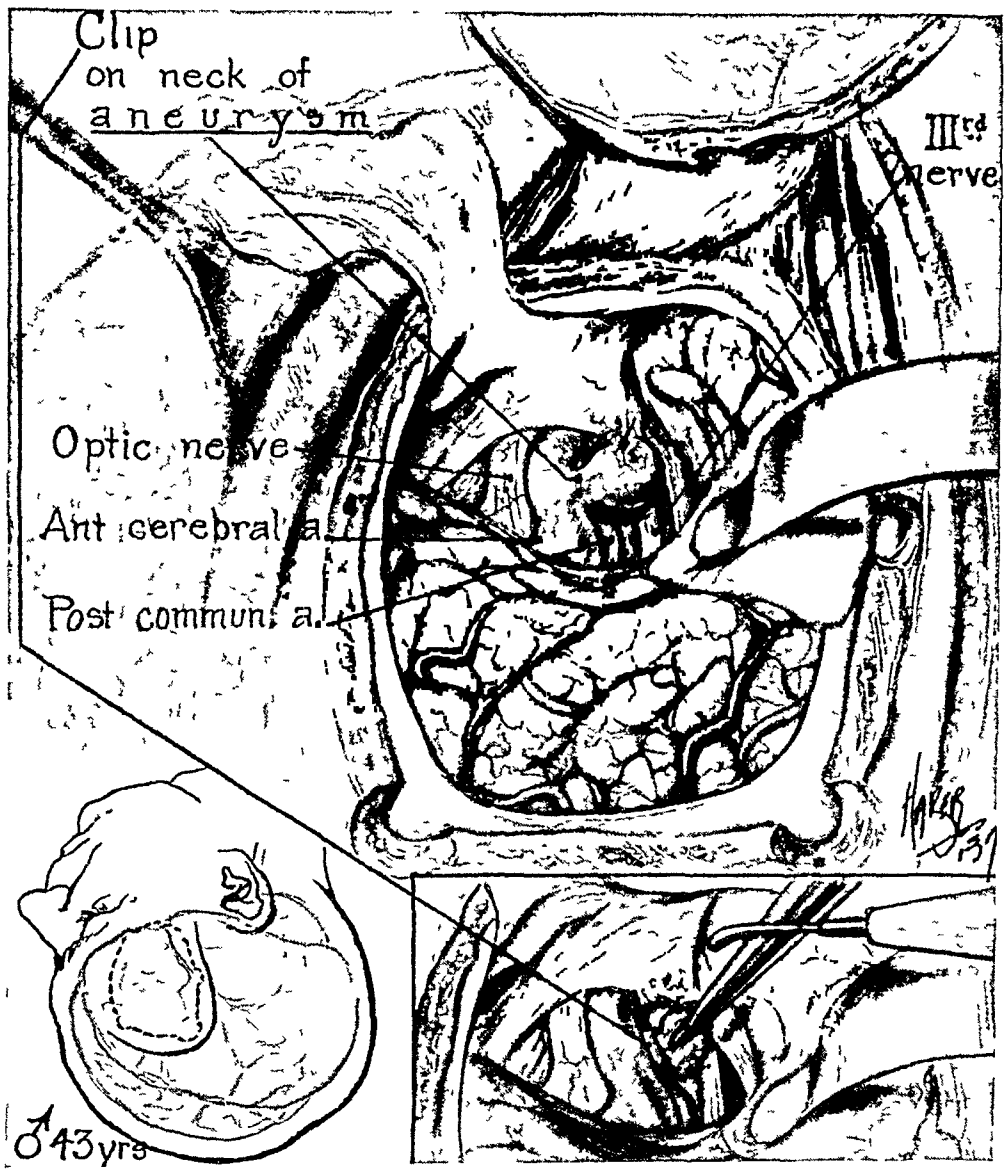


FIG 4.—Drawing of aneurysm Inset on the left shows the operative approach with the author's concealed incision Inset on the right shows clip placed on the neck of the aneurysm and the cautery shrivelling the sac

attack surely had little chance of curing the aneurysm but there then seemed no other rational effort indicated The present case is a sequel to this unsuccessful attempt The precise point of origin of this aneurysm could not be predetermined, it might have arisen from the carotid or the posterior com-

municating artery, the latter was our impression at the time of operation If it had arisen from the posterior communicating artery it was hoped that a silver clip could be placed upon the artery on each side of the aneurysm if there was not a satisfactory neck by which the aneurysm could be attached directly

A number of publications have appeared in recent years indicating that aneurysms of the circle of Willis are quite common It is from them that most of the subarachnoid hemorrhages arise Unfortunately, in most instances there are no localizing signs by which the position of the aneurysm or, indeed, the size of the aneurysm can be estimated Those with paralysis of the third

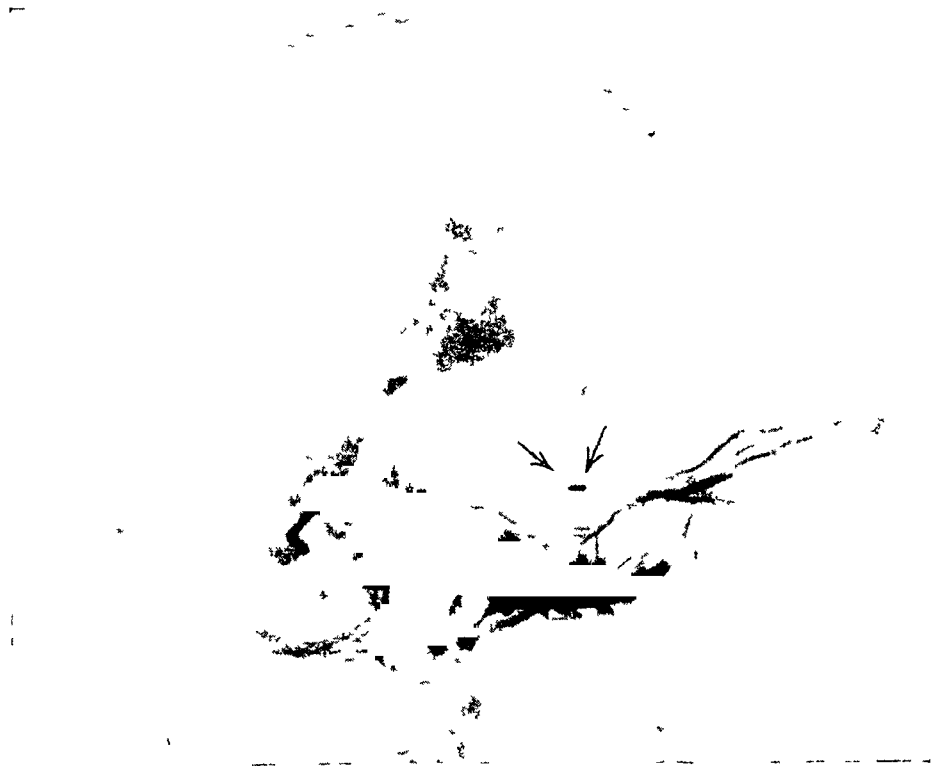


FIG 5.—Roentgenogram showing the silver clip at the sella turcica It also shows the size and position of the bone flap

nerve, as in our case, are exceptional Sands[4] makes the statement that 47 per cent of those along the posterior communicating artery produce signs referable to the third nerve Certainly those with palsies of the third nerve may be given the chance of surgical cure On the other hand, there is no assurance that the aneurysm after its disclosure may be amenable to surgical attack—the aneurysm may be too large, or it may be placed too far posteriorly on the posterior communicating artery Under the latter condition perhaps a single clip anterior to the aneurysm might be effective, or the aneurysm, if arising from the carotid, may be less favored by a narrow neck by which it can be isolated and cured by the application of a silver clip The present effort is but a beginning or a suggestion that an aneurysm at the circle of Willis is not entirely hopeless A word may be added concerning the cauter-

ization of the aneurysm by which it is shriveled to a small shred The silver clip, of course, added the same sense of security against an extending thrombus, which, I should think, would be quite likely if the cautery were used alone, but perhaps no more probable than by a spontaneous thrombosis, which may conceivably occur At least I should be fearful of such an outcome without the intervening clip to prevent its spread Should the outlook be hopeless one would, of course, be justified in this attempt, and it is not inconceivable that even then a cure might result from thrombosis of the aneurysm without extension into the main arterial trunk

In general, the indications for operation on aneurysms at the circle of



FIG 6.—Roentgenogram of the base of the skull showing the position of the silver clip placed upon the neck of the aneurysm

Willis and causing only subarachnoid hemorrhage, are none too clear Certainly without a knowledge of the side of the circle of Willis upon which the aneurysm is located there would be no justification in exploring either side in search of the lesion When a patient has had a subdural hemorrhage and has recovered, one is loath to suggest an operation, which certainly would be classed as hazardous, because another hemorrhage may never occur, at least many go for years with no further trouble, although this is not the usual story During a subarachnoid hemorrhage and the immediate period thereafter one would not dare operate because the intracranial room needed for operation would be occupied by blood—and one needs all the room obtainable for the operation For cases with a third nerve palsy the indications are clear enough And where subarachnoid hemorrhages are recurring and the eventual outlook seems hopeless I should feel inclined to advise operative attack if there is even a suggestion that the aneurysm may be on one side

Arteriography may here become an important means of locating one of these aneurysms around the circle of Willis Then, too, the frequency of multiple aneurysms, and under such circumstances the difficulty of locating the one that is at fault, make the problem of therapy an even more difficult one

So far as I know, this is the first attempt to cure an aneurysm at the circle of Willis by direct attack upon the aneurysm

REFERENCES

[1] Albright, Fuller The Syndrome Produced by Aneurysm at or Near the Junction of the Internal Carotid Artery and the Circle of Willis Johns Hopkins Hosp Bull, 44, 215, 1929

[2] Dandy, Walter E Carotid-Cavernous Aneurysm (Pulsating Exophthalmos) Zentralbl f Neurochir, 2, 77, 1937 Also ANNALS OF SURGERY, 102, 916, 1935

[3] Forbus, Von Wiley D Ueber den Ursprung gewisser Aneurysmen der basalen Hirnarterien Centralbl f Allgemeine Pathologie und Pathologische Anatomie, 44, 243, 1928–1929

[4] Sands, I J Aneurysms of Cerebral Vessels Arch Neurol and Psychiat, 21, 37, 1929

[5] Symonds, C P Contributions to the Clinical Study of Intracranial Aneurysms Guy's Hosp Rep, 73, 39, 1923

ANEURYSMS OF THE CIRCLE OF WILLIS

A DISCUSSION OF DR DANDY'S INTRACRANIAL OCCLUSION OF THE INTERNAL CAROTID FOR ANEURYSMS OF THE CIRCLE OF WILLIS, WITH SUPPLEMENTARY REMARKS

RUDOLPH MATAS, M D
NEW ORLEANS, LA

I AM glad of this opportunity to congratulate Doctor Dandy on his third successful intracranial operation for aneurysm of the internal carotid at its junction with the circle of Willis In his first two operations, performed for arteriovenous aneurysms, in 1934, the internal carotid was occluded with an ordinary Cushing silver wire hemostatic clip, at its exit from the cavernous sinus In his third operation, March 23, 1937, the clip was also used intracranially to obliterate the pedicle of the aneurysm from the internal carotid with which it was connected In all three, the silver clip was substituted for the ligature and from the purely technical viewpoint alone, Dandy's procedure is an unique and important performance because it greatly simplifies the operation itself in one of its most essential features The third case which Doctor Dandy has just reported, is, I believe, the first operation recorded in the literature for a sacculated *arterial* aneurysm of the internal carotid, at the circle of Willis—in which the aneurysm has been cured by a direct intervention upon the aneurysm itself *without occlusion* of the parent artery This remarkable performance is accounted for by the fact that in this case, the aneurysm (in common with all the aneurysms of the circle of Willis) was very small ("size of a pea") and so well pediculated that it was possible to occlude the pedicle with the clip without encroaching on the lumen of the artery, the sac itself being completely obliterated by electrocoagulation In fact, from the description, this aneurysm is typical of the discrete sacculated, so-called *congenital aneurysms,* often multiple, which are peculiar to the arteries of the circle of Willis described by Eppinger[1] (1887), and W Forbus[54] (1928) and others, as "a dilatation attached to the arteries at the base of the brain like so many berries growing from a stem, always appearing at the bifurcating angle or forking of the arteries from which they grow" (Forbus)

The fact that in this case the aneurysm alone was obliterated without occluding the carotid itself is of decided importance technically and prognostically, since the cure of the aneurysm without interfering with the carotid circulation avoided the very serious risk of secondary brain complications from cerebral ischemia, due to incompetence of the collateral circulation in the circle of Willis This liability was to be feared especially in a chronic alcoholic subject, age 44, who developed delirium tremens after the operation,

and who had not been previously tested by a temporary compression or by a definite ligation of the internal carotid in the neck

As well shown by Doctor Dandy[2] in his recent and exhaustive monograph on pulsating exophthalmos, up to the present (1938), there are only five recorded intracranial occlusions of the internal carotid for the cure of aneurysms of this artery

The first two were *ligations* for pulsating exophthalmos (Zeller,[55] 1911, Hamby and Gardner,[56] 1933) The last three were Dandy's "clip" occlusions—two, in 1934, for pulsating exophthalmos, and the third, the present case (1937), in which an *arterial* aneurysm attached to the internal carotid was obliterated without interfering with the carotid circulation In the four cases of pulsating exophthalmos, the diagnosis was demonstrably correct, but, in the last (an arterial sac), the diagnosis was largely deductive and presumptive In all five cases, the exposure of the internal carotid was definitely planned as the direct objective of the operation and not as a mere exploratory craniotomy In all, the carotid was exposed by an osteoplastic frontal or supra-orbital craniotomy as for a hypophyseal tumor

With the exception of Zeller's patient, who succumbed to hemorrhage, caused by cutting through of the ligature in tying the knot, all the other (four) patients made good operative recoveries, but of these, only two were permanent cures (Dandy's second case of pulsating exophthalmos and his present case of arterial aneurysm) In two other cases (Hamby and Gardner's ligation and Dandy's first "clip" occlusion)—both exophthalmic arteriovenous cases—the intracranial occlusion of the internal carotid did not cure the patient, relapse occurring shortly after the operation

In Hamby and Gardner's case (1933), relapse occurred despite the previous ligation in the neck, of the internal carotid and common carotid on the corresponding side, following an unsuccessful attempt to insert a Brooks' muscle embolus into the internal carotid artery In this case, the intracranial ligation of the internal carotid failed but marked symptomatic relief followed the ligation in the neck, of the opposite common, external and internal carotids, 14 days after failure of the intracranial ligation This patient finally recovered completely, but not until the arteriovenous fistula had become closed by spontaneous thrombosis

In the other patient (Dandy's first intracranial clip occlusion of the internal carotid, in 1934) relapse occurred despite the previous and successive ligation of the corresponding common, internal and external carotids In view of the relapse after the intracranial ligation (clip occlusion), the *external* carotid and its branches were ligated and several operations upon the orbital veins were performed which, in the course of nearly one year and a half after the craniotomy, gradually led to a symptomatic cure

It would seem from this evidence alone, that while the intracranial occlusion of the internal carotid for pulsating exophthalmos offers no absolute certainty of cure, it does probably improve the chances of thrombosis at the fistula when the carotid has been previously ligated in the neck, the fistula

being caught between the two ligatures When relapse occurs after the ligation of the internal and external carotids in the neck on the corresponding side, the question that arises is, what shall be the next step? Which is the safer and more certain procedure?—Dandy's intracranial occlusion with the clip, or the ligation in the neck of the opposite carotid—provided the patient has demonstrated an adequate collateral circulation by prolonged sittings of compression? And again, in extreme cases of exophthalmos, when vision is lost or irreparably damaged, is it not safer and more certain to attack the fistula directly by intra-orbital ligations, and sclerosing injections or electrocoagulation after exenteration of the orbital contents? The choice of procedure will, of course, depend upon the factors that govern the prognosis in each individual case and will be largely influenced, no doubt, by the special training and inclinations of the surgeon But, however profitable a discussion of these indications might be,* it would be here out of place except insofar as the technic of Dandy's operation is applicable to the pure *arterial aneurysms* of the circle of Willis with which his paper is especially concerned

In the meantime, we are deeply indebted to Doctor Dandy for his brilliant demonstration of the relative simplicity and apparent safety of the *transcranial* approach to the internal carotid and especially for demonstrating the great technical advantages of the clip over the ligature in this situation

The Aneurysms of the Circle of Willis—This group refers to those aneurysms that originate in the intracranial carotid and the cerebral branches of this artery which unite with those of the vertebrobasilar arteries to constitute the circle of Willis, as this lies exposed at the base of the brain These aneurysms should not be confused with the extremely small and multiple *miliary* (millet seed) aneurysms which develop from the *intracerebral* or ganglionic branches of the circle as they penetrate into the brain to supply the great central ganglia (corpus striatum, optic thalamus, caudate and lenticular nucleus, *etc*) These tenuous, thread-like arteries are predisposed, by congenital abnormalities of the arterial wall and by the degenerating effect of age and disease, to the formation of small, almost microscopic aneurysmal dilatations which, under the strain of arterial hypertension, rupture and cause the *intracerebral* hemorrhages that we recognize as apoplexy and have learned to associate with ruptured "miliary aneurysms" since these were brought to light, in 1866, by the researches of Charcot and Bouchard [57] Too small and insidious in their development to be recognized clinically, they rupture and are only discovered after death, at autopsies Thus it happens, unfortunately, that these, most numerous and most fatal of aneurysms, are also the most negative to therapy and inaccessible to surgery

By the side of these medical *intracerebral* aneurysms, we have the larger, but still small sized and much less frequent aneurysms of the circle itself and

*For my previous discussion and conclusions regarding Doctor Dandy's first paper on the intracranial occlusion of the internal carotid for the carotid cavernous aneurysms (pulsating exophthalmos), the reader is referred to the ANNALS OF SURGERY, 102, 920-924, 1935

of its primary extracerebral or cortical branches which are at present, in a very limited way, amenable to surgery While aneurysms may develop in the arteries of the circle from such varied causes as arteriosclerosis, trauma, bacterial and embolic infections, syphilis, *etc*, the group described as "congenital," also erroneously known as "miliary," is especially characteristic and distinctive of the circle of Willis and of its surface or cortical branches In an analysis of 32 aneurysms of the circle of Willis, Albright classified their etiology as (1) Mycotic aneurysms from infective emboli (2) Posttraumatic aneurysms resulting from fracture at the base of the skull (3) Aneurysms due to syphilis (4) Aneurysms associated with and probably due to atheroma (5) Aneurysms resulting from congenital defects in the walls of the cerebral vessels This largest group was recognized in 15 of the 32 cases, or 46 8 per cent [3] These aneurysms occur independently of any of the causes previously mentioned, and are "congenital" only in the sense of a histologic predisposition caused by defects in the muscular and elastic coats which favor aneurysmal dilatation by overstretching under strain

The congenital defect in the muscular coat occurs at the forking or bifurcation of the branches where these aneurysms develop and, as previously stated, appear like "minute berries growing from a stem," as is quite apparent in Doctor Dandy's illustrations They differ from the true miliary aneurysms of the deep ganglionic arteries not only by their greater rarity but by their appearance in early young adult life, whereas the deep central miliary aneurysms appear most frequently in the apoplectic age between the seventh and eighth decades

The other less typical aneurysms of the circle and its branches, in the large majority, rarely attain a size greater than that of a walnut or a cherry Larger aneurysms, up to the size of a hen's egg or tangerine orange, are extremely rare When they do attain this size they are almost always attached to the trunk of the internal carotid or the basilar artery Owing to their silent development and early rupture, their symptomatology is usually submerged and lost in the clinical picture of limited subarachnoid leakings or overwhelming apoplectic hemorrhages A congenital and anatomic predisposition to localized dilatations in the arteries of the circle of Willis (Eppinger, Forbus), with senile atheroma or presenile arteriosclerosis, combined with the increasing arterial hypertension of maturity and old age are the dominant causes Contrary to general belief, syphilis or other systemic diseases and infections play a relatively small rôle in the etiology of these aneurysms (Trumbull,[4] Fearnsides,[5] *et al*) It is the predominance of these three etiologic factors that accounts for their growing frequency at postmortems and in the surgery of the brain And yet, compared with their postmortem frequency, it is only in late years that these aneurysms have made their appearance in the literature

Clinical Rarity—To illustrate the comparative rarity of their clinical recognition, Wichern,[6] as late as 1912, was able to find only seven cases in the literature in which a diagnosis had been made *intra vitam* In this respect the contrast between the silent *intracranial* arterial and the noisy arteriovenous

aneurysms is very notable In comparison with the 617 cases of arteriovenous (carotid-cavernous) aneurysms which Hanford and Wheeler[7] were able to collect from the literature in 1930, and Dandy's[8] statement that "In fact I think they occur with greater frequency than all arteriovenous aneurisms combined, there are now reports of more than 800 in the literature", K Henner,[9] of Prague, estimates that the total number of the pure *arterial*, sacculated aneurysms of the internal carotid reported in the literature up to 1937, did not exceed 100

Incidence—These aneurysms, as found in the total autopsies, according to Wallesch,[10] are about 0 1 per cent Lowenhardt,[11] based also on postmortem material, stated the incidence, in 1924, at 0 2 per cent, and over According to Wallesch, the distribution of 279 intracranial aneurysms of the circle of Willis as compiled from autopsy records is as follows Middle cerebral, 25 1 per cent, basilar arteries, 16 1 per cent, internal carotid, trunk, 13 9 per cent, anterior communicating, 13 2 per cent, anterior cerebral, 7 5 per cent

Lowenhardt[11] had previously reported the middle cerebral as the artery most frequently affected (12 out of 22 aneurysms) Wichern[6] also, in 1912, had quoted the middle cerebral eight times in 22 cases Busse[12] (1921), on the other hand, estimates the anterior communicating as the seat of aneurysms in 10 per cent of the cases reported as occurring in the circle of Willis In a later study by Hermann Sikl,[9] of the Anatomical Institute of Prague, embracing the five years 1931–1935—in approximately 9,000 autopsies—he counted 19 such intracranial aneurysms, in which the proportion of the ruptured to the unruptured was 13 5

According to Fearnsides,[5] intracranial aneurysms from all causes were found in 4 42 per thousand of the autopsies held in the London hospitals, between 1907–1913, of these, 2 5 per cent had ruptured causing fatal apoplectic hemorrhages Herz[13] (1909), in a postmortem study of 322 cases, found that in 147 the aneurysms had ruptured Reinhardt,[14] in ten cases recorded, eight ruptured, and Lebert,[15] as far back as 1866, had recorded 86 intracranial aneurysms recognized at autopsy, of which 48 had ruptured

McKinney, Acree and Stoltz,[16] in reporting eight cases which had come under their observation at the Neurologic Institute of New York, during the four years preceding 1936, estimated the incidence of the intracranial aneurysms of the internal carotid of all types as one to 700 patients admitted to the clinic for organic nerve disease Dandy, in 1928, estimated the incidence of aneurysms in a large neurologic center at 0 5—1 per cent of brain tumors

Of course, these clinical statistics can only be regarded as merely gross approximations to the incidence of the aneurysmal disease of the brain, when we consider the frequency with which the miliary and small "berry" aneurysms of the circle escape detection in the postmortems of apoplectic hemorrhages Surely, the statistics of aneurysms of the circle of Willis should not include the congenital corticopial cirsoids, venous angiomata of the convexity of the brain, the meningiomata of the dura, or the cerebellar hemangioblastomata which were originally described by Lindau,[58] Von Hippel,[59] and so admirably

studied in recent years by Cushing and Bailey,[17] Dandy, Elsberg, DeMartel[18] and others here and abroad Though the researches of these investigators have created a new chapter in the pathologic angiology of the brain which they have invested with a series of new and vivid clinical pictures, inconceivable 25 years ago, these growths are not aneurysms in the sense in which we are applying this term

On the other hand, the constant expansion and aggressiveness of brain surgery is adding rapidly to the number and variety of clinically unsuspected intracranial aneurysms discovered at operation and others detected by improved methods of clinical visualization and exploration

Diagnosis —The difficulties in the way of correct diagnosis and localization of the intracranial arterial aneurysms of the circle of Willis are easily appreciated when we consider their small size, their insidious and silent development, and early rupture But even when they have attained sufficient size to cause definite signs and disabling symptoms, their clinical physiognomy, only too frequently, escapes detection even under the eye of the most expert observers

A brief study of Borchardt's[19] summary of 11 craniotomies performed for various indications by ten distinguished German surgeons and one American, in the period from 1909–1925, in which unsuspected intracranial aneurysms were discovered at the operation or later at the postmortem—is quite sufficient to show how often the diagnosis has been missed despite the ablest surgeons and most modern diagnostic equipment

On the other hand, preoperative diagnosis of intracranial aneurysm is not so difficult when the aneurysms are large enough to cause pressure signs or "neighborhood complaints" in certain well defined areas such as those developed in the anterior and middle fossae where they involve the cranial nerves—the optic and olfactory, in the middle fossa, and the third to the sixth as they enter the cavernous sinus to supply the eye and orbit For example, a glance at an anatomic plate showing the relation of the cranial nerves from the third to the sixth as they enter the cavernous sinus will clearly explain the progressive ophthalmoplegia (ptosis, dilated pupil, fixed or squint eye, with ocular and orbital radiations of pain) which follows the involvement of the third, fourth, fifth, and sixth cranial nerves as the aneurysm encroaches on the floor of the fossa This usually occurs without loss of vision or notable changes in the eyegrounds, the optic and olfactory nerves being too far away to suffer from the pressure of the aneurysm in the middle fossa This ocular syndrome was present and recorded in the histories of 32 patients analyzed by Albright[3] (1929), in whom the clinical signs of aneurysm of the middle fossa were confirmed at autopsy or at operation In the three operated cases of this group, the surgeons—Victor Horsley, Magnus, and Dandy—were led by the eye signs to the correct localization of *tumors* of the middle fossa but which were not recognized as such until they were exposed by operation This ocular, middle fossa syndrome was first noticed by James Adams,[20] of London, as far back as 1869 Forgotten, apparently, it was independently revived by Foix,[21]

Paris (1920, P Mollei,[22] Berlin (1921), and made particularly impressive by C P Symmonds,[23] London (1923), and later elaborated by Albright,[3] Baltimore (1929) Later still, E Bramwell[24] (1934) and all the contemporary neurologic texts have laid stress on its importance as a localizing guide to tumors or cysts in the middle fossa, or aneurysm, especially when its aneurysmal character is suggested by the relief of pain and other symptoms on compression of the common carotid in the neck, and, more conclusively, by the radiopaque visualization of the aneurysms in angiograms of the skull The value of the ophthalmic "cavernous" syndrome in determining the localization of an aneurysm in the middle fossa is well illustrated in Doctor Dandy's last case of intracranial occlusion of the carotid for an arterial aneurysm, without the aid of roentgenography And the same may be said of a previous case of intracranial carotid aneurysm reported by Albright, in 1928, in which the diagnosis of a leaking aneurysm was definitely established by the same typical ophthalmoplegic syndrome before Doctor Dandy was called upon to ligate the internal carotid in the neck

Leakage and Rupture—The diagnosis of aneurysm and its localization are made much more apparent among those who survive the leakage or rupture of an intracranial aneurysm Bleeding from small leaks tends to form a false aneurysm, much larger than the original one, and thus aggravate the signs of pressure The leak recurs at variable intervals particularly under strain, and usually ends in a final deluge At other times, rupture occurs with an overwhelming extravasation into the subarachnoid space and apoplectic death The blood stained cerebrospinal fluid or an xanthochromic tinge, when the hemorrhage stops and the patient survives, give convincing proof of the rupture The symptomatology of leakage and rupture is extremely variable Some of the larger aneurysms may become firmly encapsulated and make little progress for years, but this is extremely rare, especially in small aneurysms of the inner circle of Willis itself

Differential Diagnosis—There is hardly any error possible between the bulging, throbbing eyes of a noisy *carotid-cavernous* fistula and the silent, closed and paralyzed eyes of the *arterial*, carotid aneurysm of the middle fossa

The most frequent of all diagnostic errors is that of mistaking an intracranial carotid aneurysm for supra- and parasellar cysts and tumors of the pituitary In fact, the majority of the aneurysms of the intracranial carotid reported in recent years have come to operation under the diagnosis of pituitary or parasellar tumors

And yet it is in this group, also classed as the *suprachinoid* to distinguish from the infraclinoid or lower parasellar group, that ophthalmology is capable of rendering the greatest service in the differential diagnosis of the seat and pressure effects of the lesion In contrast with the strikingly disfiguring but not blinding effects of the painful (neuralgic) ophthalmoplegias of the non-fistulous aneurysms of the middle fossa, those of the suprasellar region show no external or outer disfigurement from ptosis or other oculomotor palsies, but their far greater peril to vision is revealed by their damaging effect on the

visual pathways (optic tract, optic nerves, chiasma and cortical centers) when their eyegrounds and visual fields are tested Total and unilateral amaurosis, monocular amblyopia, scotoma, bitemporal homonymous hemianopsia, with contracted and changing patterns of visual fields, are examples of the ophthalmic disorders that are met in the casuistry of intracranial carotid aneurysms as they are recorded even in the old literature, when the correlation of the clinical findings with the aneurysm was only discovered or confirmed at necropsy * In our day, the cases in which the preoperative diagnosis is confirmed by operation are not rare but it happens only too often that a surgeon who is exploring quite accurately for a brain tumor or cyst in the sellar or parasellar region stumbles across an unsuspected aneurysm More unfortunate still is the patient in whom the clinical evidence clearly points to an aneurysm, and at the operation a tumor is exposed, correctly enough where it was expected to be, yet, when it is exposed, it is so firm and pulseless that its aneurysmal character is doubted, a puncture and aspiration is also negative and the diagnosis of aneurysm is abandoned in favor of a nonvascular cystic tumor Emboldened by the negative result of the aspiration, the operator incises the supposed cyst to evacuate its contents and as he is curetting the grumous contents he is suddenly startled by a fierce jet of blood which dramatically proclaims the deception

Just such an episode was recently reported to the French Academy of Surgery in a very instructive and conscientious report of an aneurysm of the right intracranial carotid by Jirasek, K Henner and H Sikl,[9] of Prague, which illustrates the fallacies that underlie the diagnosis of intracranial carotid aneurysms despite the most thorough study of the patient from every imaginable point of view by a surgeon, a neurologist and a pathologist, respectively, of the greatest experience and ability, at the head of one of the best equipped clinics in Europe

Case Report—The patient, a civil engineer, age 44, seemingly sound physically and mentally, Wassermann negative, and whose chief complaint was a constant right-sided headache, which had gradually grown worse in the course of three years before he came to the clinic for consultation All neurologic, serologic and roentgenologic examinations had proved negative except for a slight increase in the blood pressure with incipient atrophy of the optic nerve and a left-sided hemianopsia with slight refractive visual errors, and nystagmus to the left Repeated examinations were made in the course of six years during which the patient was kept under observation in the growing conviction he had a supra- or parasellar cystic tumor, for which systematic roentgenotherapy was applied, as he refused all operative interference and even a ventriculogram The roentgenotherapy was followed by a remarkable improvement in his subjective symptoms (violent temporal and frontal headaches, and enlarged fields of vision, the ophthalmic signs remaining practically unchanged) The improvement, however, did not continue and the patient finally consented to an exploratory craniotomy with the probable extirpation of a right-sided cystic tumor of the parasellar region in view

* For the latest, most thorough, illuminating and authoritative study of the ophthalmic relations and phases of the intracranial aneurysms, the reader is referred to the essay by Geoffrey Jefferson,[5] F R C S which, unfortunately, reached the present writer too late to utilize, in all its far reaching diagnostic and surgical bearings, for this discussion

Operation—April 2, 1936 Professor Jirasek of Prague A frontal osteoplastic flap was turned down and the trunk of the carotid exposed as it rested on a pulsating, ovoid mass alongside of the optic nerve, which immediately suggested the diagnosis of aneurysm of the internal carotid outside the cavernous sinus A puncture with a large aspirating needle was followed by the discharge of a thick, grayish liquid, but no blood The suspicion of an aneurysm not being confirmed by this test, the operator proceeded to cautiously incise the thick dural cover of the tumor Emboldened by the negative result of the incision, a blunt curette was introduced into the opening and a quantity of soft, grayish, grumous material was scooped out of the interior of the tumor The tumor itself seemed to be of a cystic character, filled with very thick, hard, grumous material which did not reveal its true origin until the fourth curetting, when suddenly a powerful jet of blood instantly flooded the field, demanding the immediate concentration on the hemorrhage, which was first controlled by digital compression and then by packing with gauze, leaving a strip projecting outside of the wound, which was closed after suturing the dura above the drain The patient, however, never recovered consciousness and died in coma the next day, about 24 hours after the operation, despite transfusions and other efforts at restoration

Autopsy revealed a true aneurysm of the internal carotid, apparently caused by a leak as this artery emerged from the cavernous sinus The aneurysm was apparently undergoing progressive thrombosis or coagulation of its contents and was on the way to a possible spontaneous cure by the thrombotic process The presence of this dense clot probably coincided with the marked relief obtained by the patient at the time that he had been subjected to a systematic roentgenotherapeutic regimen It is possible that clotting was induced by this treatment, thus checking the further development of the aneurysm and in this way affording marked relief to pain and other symptoms that he had complained of so bitterly The relief, however, was temporary, and was not appreciable as regards the impaired vision from the optic atrophy, which had been recognized before the operation

The operator in this case accounted for the coma and death by the increased intracranial pressure caused by the hemostatic pack, and probable edema of the brain The transfusions raised the blood pressure from 105/65 to 145/75 and kept it up at this level, but had no effect in restoring consciousness

In Trevani's[26] case (1932), the hemorrhage was controlled by a hasty ligation of the common carotid in the neck, but the patient did not survive over three hours In the first recorded case of intracranial carotid aneurysm, the operator, Victor Horsley, about 1902, ligated the common carotid on discovering that the tumor he had exposed in the middle fossa by craniotomy was an aneurysm Magnus, in 1927, also ligated the common carotid to control hemorrhage from an aneurysm which he had mistaken for a tumor of the gasserian ganglion In a case quoted by Reinhardt,[14] a man, age 41, who presented all the ocular symptoms of the typical "cavernous" syndrome of a carotid aneurysm in the middle fossa presented a pulsating tumor which projected into the left maxillary sinus The tumor was incised and a profuse hemorrhage ensued, from which the patient died shortly afterwards At autopsy a large aneurysm of the left internal carotid was found, which had caused compression of the brain, and which had eroded its way from the base of the skull through the ethmoid and floor of the orbit into the maxillary sinus, where it was incised, because of a mistaken diagnosis Other episodes could no doubt be quoted in further proof, if such were needed, of the fallacies

that underlie even our best judgment in dealing with intracranial aneurysms.*

The most impressive lesson that we gather from the study of the aneurysms of the circle of Willis is the comparative rarity of the *surgical* aneurysms, that is, aneurysms of sufficient size to make them recognizable by the clinical methods of investigation, and in time, perhaps, amenable for a curative surgical intervention, as in Doctor Dandy's case. This is very unfortunate when we consider the great frequency of the small medical aneurysms, especially those of the miliary or "berry" type which rupture and cause apoplectic deaths long before they have grown to a recognizable size.

In the rare aneurysms which grow slowly and attain considerable size, their behavior and symptomatology are indistinguishable from that of the solid or cystic neoplastic growths with which they are generally confused, as in the example just quoted from the Prague clinic. What is wanted in all doubtful cases—and that means the vast majority—and before any thought of operation is entertained, is the proof that the tumor is an *aneurysm* and not something else.

Roentgenographic Examination.—Much hope was entertained that roentgenograms would help materially in the differentiation of aneurysms from endocranial tumors. But long experience has proved that roentgenography, by itself, is disappointing in the great majority of the cases. Calcification of the sac in placques or rings, erosion, thinning and alterations in the outline of the sella, or of the optic fossa and sphenoidal fissure and cranial bones at the base, are all suggestive and helpful when combined with the clinical history and other evidence. But roentgenograms of the skull are of the least value when they are most needed for the differential diagnosis of the arterial aneurysms. While Sossman and Vogt,[27] McKinney, Acree and Stoltz,[16] Abl,[28] Wakely[29] and others, lay much stress upon the value of roentgenograms of the skull for the diagnosis of the intracranial aneurysms, general experience teaches that in this field the evidence furnished by the roentgenogram is more often negative or merely suggestive, and of very secondary importance to the visualization of the arteries and the circulation of the brain by angiography.

Cerebral Angiography.—Very notable progress in the diagnosis of the intracranial aneurysms, and of all vascular tumors of the brain, has been accomplished since the introduction of cerebral arteriography, or encephalography, by the injection of radiopaque solutions into the carotid circuit, since this method of exploration was introduced and developed by Egaz Moniz, of

* "There are few hospitals but boast some story of disaster befalling a surgical Mandarin when he made what sounds to be the juvenile mistake of incising an aneurysm. Those more familiar with aneurysms will extend their sympathy, for pulsation may have been imperceptible, the tumor apparently solid. Nevertheless the smoothness of the aneurysmal wall and its freedom from fine capsular vessels is generally sufficient safeguard against mistake. Even if it is incised, the dark brown clot contained in it should give an immediate clue to its nature. As will be related below, one aneurysm in the present series was tentatively incised and three others were needled with informative results and without mishap." (Geoffrey Jefferson[25])

Lisbon, in 1924 We believe that if there is a special field of usefulness for angiography it is in its application to the differential diagnosis of the aneurysms and vascular tumors of the brain That this specific utility is not a vain expectation is shown by the positive preoperative diagnoses of occult, intracranial, carotid aneurysms reported by Dott, of Edinburgh (1933), Moniz (1934), Tonnis (1934), E Bramwell (1936), Sjoquist[30] (1936), DeVet and Zeckel[31] (1937) and many others who are making angiograms freely for diagnostic and prognostic purposes (Loman and Myerson[32] [1936] in the United States, Olivecrona[33] and Lindblom[34] in Sweden [1936], Lindon,[35] Australia [1936], Kobcke,[36] Germany [1936], Sai[37] and associates in Italy, Jefferson,[25] Manchester, Eng [1937])

In 1934, when the second edition of Moniz's[50] monograph appeared, he and his Portuguese associates had made over 300 cerebral arteriograms without a fatality, after he had abandoned sodium iodide for thorotrast, in 1931 This same claim is made by Lohr[38 39] of Magdeburg (1937), the leading advocate of the method in Germany, whose large experience in hundreds of cases, reported in numerous publications since 1931, has given him great confidence in the value and safety of the method The same view is sustained by the large experience of Makato Saito[40] and his Japanese collaborators (1935–1936), who used l'ombre, a modified lipiodol compound, and of Reboul[41] (Paris, 1935–1936), with tenebryl, a new organic iodine compound Judging by these notable examples, we can well imagine that if all the authors specifically concerned in Cerebral Angiography whose names appear in the long list of references to "Roentgenography," "Cerebral Arteriography," "Angiography," and "Arterial Encephalography," in the Index Catalogue of the Army Medical Library,[42] were quoted separately, the aggregate of the combined collective world-experience in cerebral angiography alone would probably amount to several thousand successful cases, not including the innumerable applications all over the world that have been made, and are now being made, of arteriography in exploring the blood vessels of the extremities and other parts The beautifully clear arteriograms that are obtained by this method with thorotrast, and the comparative simplicity of its technic, make it most appealing to the clinician, especially since Moniz simplified the technic of the procedure by demonstrating that the injection of the *common* carotid as it is exposed in its most superficial course in the neck yields as good, if not better, visualizations than those obtained by injecting the more difficultly approached *internal* carotid, as at first thought necessary

While there are, no doubt, objections to all the methods of visualizing the arteries by injecting them with radiopaque solutions, even with thorotrast—the best tolerated and the least noxious of these—the risks involved in the procedure (trauma to the artery and the retention of thorium in the tissues, and remotely possible cancerigenous tendencies, in predisposed individuals) are relatively negligible, as abundant experience has shown, in competent and experienced hands

Nor is arteriography absolutely infallible in revealing intracranial

aneurysms, since it is liable to errors of technic and may fail to delineate a small thrombosed sac, or the minute "miliary" and "berry" aneurysms may be obscured by other shadows On the other hand, when an aneurysm is successfully injected, the demonstration is conclusive and final The chief objection to thorotrast is its radioactivity, and possible permanent fixation in the tissue But in the doses used in cerebral angiography it would seem to be practically innocuous Despite recent observations which show that thorium particles have been found retained in the vessel walls and extravasates of leaking cerebral aneurysms (Northfield and Russell [1937]),[43] the fact remains that no permanent bad effects have been observed clinically, in the vast majority of the reported cases In this connection serious objections also might apply to cerebral ventriculography, and particularly encephalography by the spinal route, which, despite its large share of accidents and fatalities, is currently employed as a most valuable diagnostic aid in neurosurgical practice * What is now most desirable is to find a substitute for thorium of equal radiopaque efficiency, but free from radioactive properties In the meantime, angiography with *thorotrast* has become one of the most valuable diagnostic acquisitions of brain surgery, provided it is used with discretion, and only for cases in which a diagnosis of vital importance cannot be effected by other means—which is precisely what obtains in the great majority of the intracranial aneurysms and especially those of the circle of Willis

Treatment.—Up until the turn of the century, no surgical treatment had been opposed to the arterial intracranial aneurysms of the carotid tract and of its branches in the circle of Willis These aneurysms were only known clinically by the paralytic or apoplectic effects of their rupture and by the postmortem findings On the other hand, the arteriovenous aneurysms of the intracranial carotid (pulsating exophthalmos) had been fully recognized and attacked, as early as 1809, by Benjamin Travers,[60] and the extracranial ligation of the common or internal carotid had been the classic treatment for nearly a century before the first ligation of the internal carotid for a sacculated arterial aneurysm of the middle fossa was performed by Victor Horsley, in 1902 C F Beadles,[44] describes a case operated upon by Victor Horsley, who performed a craniotomy on a woman, aged 48, for a pulsating tumor of the middle fossa of the skull, which had all the characteristics of an aneurysm as revealed at the operation, except that it was silent and caused no murmurs which could be heard, even with the sterilized stethoscope applied to its surface Without going further in the exploration, the right common

* No doubt still greater objections have been made to "iodoventriculography," by which an almost diagrammatic visualization of the ventricles is obtained with lipiodol as a radiopaque solution instead of the air injections usually employed And yet, in the Neurosurgical Institute of Buenos Aires, under Prof M Balado (Director), this mode of ventriculography has been in use for the last eight years, in over 550 applications, with seeming safety, and which have resulted in the greatest successes from the diagnostic point of view (Ref R Carillo Iodoventriculographic Diagnosis of the Surgical Diseases of the Posterior Fossa Archivos Argentinos Neurolog, 17, 71–92, July–August, 1937)

carotid was ligated in the neck, and "now, about five years after operation, the patient is in extremely good health"

According to the same authority (Beadles), Horsley had successfully ligated both carotid arteries in the neck for supposed intracranial aneurysm, and this operation was performed 12 years before the case just described, as cited by Dr W W Keen,[15] in 1890 At the operation a large cystic tumor in close proximity to the internal carotid artery was seen and diagnosed as an aneurysm, because of pulsation and loud systolic bruit heard in the temporal region The tumor continued to be regarded as an aneurysm until "the patient died some years afterwards and the supposed aneurysm proved to be a large blood cyst connected with the anterior part of the pituitary gland"

The reason for this long delay in attacking the *arterial* aneurysms in this way has been already explained by the gross objectiveness of the arteriovenous aneurysms and the injuries of the base of the skull which caused them, which commanded immediate attention, whereas, the arterial aneurysms usually remain occult, silent or confused with other tumors and disorders of the brain until rupture and death The difficulty in recognizing them clinically accounts for the fact that the first two extracranial ligations of the internal caroid for these aneurysms were performed as emergencies, on discovering that the tumors of the middle fossa exposed by craniotomy were apparently aneurysms, the carotid being then ligated in the neck to prevent hemorrhage (Horsley,[44] 1902), or to control intracranial hemorrhage as in Magnus'[46] case (1927), and Trevan's[26] and Jirasek's[9] cases previously referred to

Among the scant references to treatment, we find two cases operated by Cushing in which a preoperative diagnosis of ruptured aneurysm had been made one an exploratory craniotomy which the patient survived for over a year, reported by Symmonds[23] (1920), and the other a subtemporal decompression, in 1920, reported by Veits[47] ended fatally Another decompression by Elsberg (1917), reported by Packard and Zabriskie,[48] for a ruptured aneurysm of the right middle cerebral artery, also ended fatally shortly after the operation

The first ligation of the internal carotid in the neck for a leaking intracranial aneurysm, recognized preoperatively as such, was performed by Dandy at the Johns Hopkins Hospital in 1928, unfortunately, the collateral circulation failed and the patient died hemiplegic and in coma, despite prompt removal of the ligature The autopsy revealed two aneurysms of the middle cerebral artery which complicated the situation and precipitated a thrombosis in the circle of Willis In the meantime, Zeller in Germany (1911), and Hamby and Gardner in the United States (1933), were pioneering with the *intracranial* ligation of the internal carotid for pulsating exophthalmos, a surgical feat which Dandy accomplished three times with success, including his last ligation for a pure arterial aneurysm of the circle of Willis, which he has just reported

The intracranial ligation of the internal carotid at its junction with the circle of Willis marks a transition stage, and an advance of great importance in the treatment of the intracranial aneurysms of the basal arteries which are not

amenable to control by the extracranial carotid ligations It is an achievement which is destined to lead the way to more frequent transcranial attacks upon these aneurysms, especially as the methods of clinical visualization by arteriography improve and the aneurysms are visualized, not merely as tumors but as aneurysms There is no possible doubt that, since the methods of clinical investigation have been reinforced and made infinitely more effective by angiography and ventriculography, the number of reported intracranial aneurysms, cured by surgery, has increased in the last five years at a rate which has exceeded all previous experience or expectations

In the two cases recently reported by Norman Dott[49] of Edinburgh (1933), with one cured by carotid ligation, the two reported by Moniz[50] (1934), with one also cured by carotid ligation, and another carotid ligation, fatal from numerous complications, by Tonnis[51] (1934), the aneurysms were visualized by angiography The cases of McKendree and Doshay[52] (ligation of common and internal carotids) (1936), and Walsh and Love[53] (1937), were followed by recovery and cure of the aneurysm In the latest case (Walsh and Love), diagnosed as infraclinoid aneurysm of the right internal carotid artery, the history of leakage confirmed by xanthochromic cerebrospinal fluid, and the ophthalmic syndrome—so typical of aneurysms of the middle fossa—made the diagnosis so clear and unmistakable that no roentgenogram was even deemed necessary The internal carotid, ligated under local anesthesia after the usual tests of efficiency of the collateral circulation in the circle of Willis, resulted in uncomplicated cure with the relief of all symptoms

It is safe to say that the ligation of the internal carotid for the endocranial aneurysms of this artery gives a far better prospect of permanent cure than a ligature applied to the same artery for the cure of the arteriovenous aneurysms For in the sacculated *arterial* aneurysms there is no fistula at the cavernous sinus through which the distal collaterals may feed the fistula and cause relapse

It may be said from this evidence that the extracranial ligation of the internal or common carotid, preferably the internal carotid, for the cure of intracranial carotid aneurysms, remains the safest and surest method of attack for all the aneurysms of the sellar, parasellar and infraclinoid *carotid tract*, provided the efficiency of the collateral circulation is duly tested by prolonged sittings of compression of the common carotid in the neck

On the other hand, no curative effects from the carotid ligations in the neck can be expected in the aneurysms that rise from the branches of the circle of Willis, and especially those of the posterior cerebral, the basilar, the cerebellar and the intracranial vertebrals, at their junction in the basilar trunk, as these aneurysms are too well supplied collaterally by the vertebral vascular system to expect them to be stagnated or affected by the carotid ligations These aneurysms could be best approached, theoretically at least, by the posterior fossa or cerebellar route, as in dealing with the cerebellar and pontocerebellar tumors and cysts of the subtentorial space But of this group of aneurysms, we know of no actual surgical experience that would

serve as a foundation or precedent for their surgical attack, though there is no lack of clinical studies correlated with postmortem findings to tell the modern neurosurgeon how to face the complex problems of this formerly forbidden area, with decided prospect of success

CONCLUSIONS

(1) From the preceding statements it is evident that, despite the notable progress accomplished in the surgical treatment of the intracranial aneurysms of the carotid tract, only a small fragment of a large subject has been dealt with We realize this therapeutically, by the fact that the smallest, the most frequent, and the most fatal of all aneurysms—the *miliary aneurysms* of the central ganglionic branches of the circle of Willis, which are responsible for over 80 per cent of the 97,000 deaths caused by cerebral hemorrhage annually in the United States (census of 1935)—are entirely beyond the scope of surgery The only hope for a reduction in the mortality from this cause lies in the social and hygienic recognition of the causes of the miliary aneurysms and the conditions that favor their rupture congenital defect and degeneration of the arterial wall, and chronic arterial hypertension, which are essentially the concomitants of maturity and old age and of presenile arteriosclerosis

In their frequency and fatality, the tiny miliary aneurysms of the brain are close rivals of the aneurysms of the aorta, which attain the largest size in the body The latter appear earlier in life than the brain aneurysms, but they are the effect of a specific cause—the treponema of syphilis, a preventable infection amenable to social prophylaxis and to specific treatment

(2) In the brain there are at least three classes of arterial aneurysms which differ in their surgical tractability (1) The *miliary* aneurysms of the central arteries which are entirely beyond the reach of surgery except when they create circumscribed hematomata in the brain substance (2) The larger *basal* aneurysms of the carotid tracts up to the circle of Willis, which it is possible to control and cure by the extracranial ligation of the internal and common carotid trunks in the neck (3) An *intermediary* group of aneurysms arising from the circle and its surface or cortical branches, including the carotid and the vertebrobasilar and cerebellar branches which are not controllable by the extracranial ligation of the parent trunks in the neck These can be dealt with only by a direct intracranial attack in *loco lesionis* with the view to their extirpation or obliteration by electrocoagulation after occlusion of the pedicle or of the parent trunk with metallic clips, *etc*, according to circumstances

(3) In view of the free access to the brain and the perfection of the operative technic which permit the contemporary neurosurgeon to expose a tumor in almost any part of the brain with relative security and success, it would seem that the means of access to a cerebral aneurysm should be subordinated, now, more than ever, to the preliminary condition, the *sine qua non*, which demands that no operation for tumor should be undertaken with-

out the accurate localization of the tumor by the usual methods of clinical differentiation and objective demonstration, supplemented, if at all possible by cerebral angiography of Moniz, which is the only procedure capable of definitely determining that the tumor is an aneurysm and not something else

The disastrous consequences of mistaking an aneurysm for a tumor in the course of a critical operation have been previously referred to, but cannot be overemphasized, though there is reason to believe that these disasters in the past will steadily diminish with constantly improving methods of arteriographic visualization While we fully realize that these methods of vascular visualization by angiography, combined if necessary with ventriculography, are still far from perfect, we are also aware that, in the diagnostic differentiation of the aneurysms and vascular tumors of the brain, Moniz and his pupils of the Portuguese schools have given us a master key which can unlock many of the still secret chambers of our endocranial vascular pathology

(4) The question that must be deeply considered after the diagnosis of the seat and the extent of the aneurysm have been determined, is the effect that its removal or obliteration may have upon the area supplied by the obliterated vessel through ischemic suppression of its blood supply In this connection, it is well to remember that it is practically impossible in the vast majority of these aneurysms to obliterate them without interrupting the circulation in the circle and seriously impairing the nutrition of the area of the brain that is supplied by the arteries given off from the circle beyond the obliterated branch Besides, it is always possible that, in extirpating an aneurysm in the circle, its obliteration may be indefinitely extended along the circle by progressive intravascular thrombosis

(5) It should also be remembered in arriving at conclusions before operation that, though the tendency and fate of an intracranial aneurysm is to end fatally in apoplectic rupture, or after a succession of leaks and limited extravasations (especially in the aged with brittle sclerotic arteries complicated with arterial hypertension), it is quite possible, especially in young subjects with fairly elastic arteries, that spontaneous cure by thrombosis may be effected in some cases, and, in others, the enlargement and rupture of the aneurysm may be indefinitely averted by the calcification and encapsulation of the sac

In closing these remarks the writer experiences a grateful moment in recalling the great privilege he has enjoyed in participating in the evolution and technical development of neurosurgery as this has developed during the last half century and the semicentennial of this society's existence

MEMORABILIA OF PERSONAL EXPERIENCE

In seeming accord with the stated rarity of the arterial intracranial aneurysms of the carotid tract as compared with the frequency of the arteriovenous aneurysms of the same artery at the cavernous sinus, it may be worthy of note that, in over 50 years of active surgical practice, during which I have

had an unusually large experience in the surgery of the carotid vessels* I have yet to record the first ligation of the internal or common carotid for an intracranial *arterial* aneurysm, despite 18 intracranial arteriovenous aneurysms that have come under my observation and treatment during this same period This, however, is not surprising, for up until the last six years, all the reported operations for intracranial arterial aneurysms could have been counted on one's fingers It is also to be remembered that modern neurosurgery has been evolved during this period, and in the matter of the intracranial aneurysms is still in the making

Speaking personally, I would say that from 1880 (the year of my graduation) the interest of surgeons in the intracranial aneurysms (with the exception of pulsating exophthalmos) was purely anatomic and pathologic As demonstrator of anatomy in the Medical School of Tulane University of Louisiana (1885–1895), I dissected and demonstrated the brain twice weekly for six months, in over 100 cadavers annually The circle of Willis and its anomalies and those of its branches were closely observed and were made the subject of frequent comment, especially when, on rare occasions, intracerebral and subarachnoid hemorrhages were found, caused by ruptured miliary aneurysms of the Charcot and Bouchard type (1866), and those of the circle of Willis described by Lebert (1866), Eppinger (1887), and later by Duret[61] (1892), and, also, the still rarer appearance of the same aneurysms as calcified beads in proof of their spontaneous curability All this furnished material for anatomic discussions in relation to apoplexy, which were entirely medical or anatomic Of course, at that time, when even the trephine was used timidly, any suggestion of direct intervention on these intracranial aneurysms was entirely too fantastic to be seriously entertained It was only for a short time, in 1895, when W Spencer and Victor Horsley suggested the ligation of the common carotid, and Cushing[62] (1908), craniotomy to evacuate the clot in the brain of apoplectics, that a momentary ripple was caused in surgical circles, which soon faded away as the suggestion was quickly abandoned and the intracranial aneurysms of the circle of Willis returned to their clinical obscurity, or only came to light in rare instances when they attained sufficient size to be confused with brain tumors, from which even now we are only beginning to distinguish them effectively since radiopaque visualization of the cerebral arteries has come to the aid of roentgenography

Reverting to my personal experiences with the intracranial aneurysms, I have the notes of five patients seen in consultation at long intervals since 1900, when lumbar puncture, which Quincke, of Kiel, had introduced, in 1895, had become a practical aid in differentiating the apoplexies caused by

* This personal experience includes 185 operations on the carotid trunks, 70 for arterial and arteriovenous aneurysms (common 52, internal 7, external 21), and 115 ligatures or band occlusions on the main trunks for nonaneurysmal conditions (common 25, external 90)—exclusive of 34 ligations of the individual branches of the external carotid for special lesions and 197 bilateral ligations of the thyroid arteries

cerebral hemorrhage (a term almost synonymous with ruptured aneurysms of the circle of Willis) and those caused by cerebral thrombosis, embolism or other nonhemorrhagic causes In all these patients the signs and symptoms pointed to apoplectic rupture or intermittent leakage of intracranial aneurysms In all of these, lumbar puncture revealed subarachnoid hemorrhage or a xanthochromic discoloration of the cerebrospinal fluid, which demonstrated that hemorrhages were in progress or had been checked spontaneously In three of these—all male patients past middle life—unconsciousness came on gradually after spells of vertigo with vomiting and intense headaches The fatal exitus came on from 12 hours to four days In two others, a man and a woman, also of advanced age, the "strokes" were not fatal and the patients recovered slowly with hemiparetic and monoplegic disabilities, stiff neck (suggestive of meningeal reactions), and "Kernig" which subsided with the gradual disappearance of the blood stain from the cerebrospinal fluid In none of these fatal cases was a necropsy performed, but in going over their histories, retrospectively, their antecedent symptomatology, ophthalmic disturbances and other pressure signs make it almost certain that these apoplexies were caused by the rupture or leakage of intracranial aneurysms of long standing

In this connection, a brief reference to the story of three *spontaneous,* nontraumatic, noncongenital arteriovenous aneurysms, established in the cranium between the arteries and veins of the carotid and jugular systems *without recognizable localization of the fistula,* is of decided interest These three patients (two men and one woman), all of mature age, 45, 66 and 71 years respectively, seemingly without provocation or premonition, developed arteriovenous communications in the brain which were announced by tinnitus and objectively demonstrable auscultatory noises in the head that were typical of the mixed arterial murmurs and the venous hums that characterize arteriovenous aneurysms of the cavernous sinus in pulsating exophthalmos Yet, in none of these patients (all living) is there any evidence of exophthalmos or ocular pulsation All these patients have passed middle age and are arterial hypertensive subjects The arteriovenous communication in each was established suddenly and without apparent cause, the patient recognizing the fact that something unusual had happened by the subjective endocranial noises that they heard as a tinnitus, and that were easily demonstrable by auscultation of the skull to the medical men who attended them Despite the most attentive and repeated examinations by neurologists, oculists and otologists, the precise localization of the arteriovenous communications could not be determined There was no serious impairment of vision, no exophthalmos, only typical systolic murmurs in the cranium, synchronous with the pulse and associated with the continuous venous hum or roar of the arteriovenous aneurysms While the diagnosis of arteriovenous fistula was unmistakable, the precise seat of the fistula could not be determined except that the bruits were heard with greatest intensity at the base of the skull, over the mastoid, temporal and retromastoid area on the side in which the tinnitus was loudest

These patients have been under observation four, five, and six years, respectively All three are going on with their regular occupations in moderation (lawyer, oil station agent, housewife) In all three, the head noises can be suppressed by compression of the common carotid in the neck, which all three have learned to apply with their own fingers The oldest of these patients, however, cannot stand compression for more than a minute without dizziness and faintness The two who have kept up the pressure exercises believe that the compression has diminished the intensity (loudness) of the murmurs

These are cases in which cerebral arteriography by radiopaque visualization should prove of inestimable value in determining the seat of the fistula, and perhaps suggesting a direct surgical method of suppressing it, but, since the patients are satisfied to endure the head noises and suffer little disability, we have abstained from any adventurous operative procedure, such as the ligation of the common or internal carotid which might aggravate the situation and possibly precipitate fatal complications

As a concluding experience in connection with the surgical history of the circle of Willis, I trust it will not be regarded as irrelevant to relate, very briefly, an experience with a gunshot wound of the cranium including the middle cerebral artery which, on account of its rarity, may perhaps be worthy of record

Case Report—Occlusion of Middle Cerebral Artery for Hemostatic Control of Intracranial Hemorrhage Edwin K, white, male, age 12, was admitted to Touro Infirmary, June 1, 1907, at 11 30 P M *Diagnosis* Gunshot injury of the head, with bullet lodged in the brain Deep coma and dying from circulatory and respiratory failure on admission

Operation—Without anesthesia, a right-sided osteoplastic temporofrontal flap exposed the dura, which was found perforated, but there was no extradural hemorrhage The dura was opened and a deluge of blood followed, the right temporosphenoidal lobe was lifted and the middle cerebral artery exposed at its origin from the internal carotid, it was torn and bled profusely In view of the patient's desperate condition—pulseless and breathing spasmodically—no attempt was made to secure the artery by ligature, but the bleeding vessel was seized with a long, narrow Pean forceps, which immediately controlled the hemorrhage The forceps was allowed to remain in situ, while the dura was closed with a few interrupted sutures The osteoplastic flap was also held in place with a few through-and-through silkworm sutures, leaving space for the forceps to project out of the wound No attempt was made to search for the bullet which was probably lodged in the opposite cerebral hemisphere The operation was performed quickly and for a moment the pulse was palpable and seemed to return, but, despite artificial respiration, cardiac stimulants and saline infusions, the circulation and respiration failed and the patient died at 1 25 A M, one hour and 45 minutes after his admission to the hospital No autopsy was obtained

This is the first case in our experience in which intracranial bleeding from a wounded middle cerebral artery has been surgically controlled at its source I have since thought that Cushing's hemostatic wire clip, used now currently in neurosurgery, could have been applied with great advantage as a permanent control of the bleeding, while a continuous intravenous blood drip would probably have tended to improve the chances of recovery, rather than the continued saline drip which was the best we could give at the time

BIBLIOGRAPHY

[1] Eppinger Arch f Clin Chir, Suppl 1, 35, 1–563, 1887
[2] Dandy, Walter E Carotid Cavernous Aneurysms (Pulsating Exophthalmos) Zentralbl f Neurochirurgie, 2, 77–204, 1937 (Printed in English)
[3] Albright, Fuller The Syndrome Produced by Aneurysm At or Near the Junction of the Internal Carotid Artery and the Circle of Willis Bull Johns Hopkins Hosp, 44, 215–245, 1929
[4] Trumbull Quart Jour Med, London, 8, 1914–1915, Brain, 41, 1918
[5] Fearnsides Brain, 39, 224, 1916
[6] Wichern Deutsch Zeitsch Nervenheilk, 44, 220, 1912
[7] Hanford and Wheeler ANNALS OF SURGERY, 92, July, 1930
[8] Dandy, Walter E ANNALS OF SURGERY, 102, 916, 1935
[9] Henner, K, Jirasek, and Sikl, H Mem de l'Acad de Chir, 63, No 14, 577–587, April 20, 1937
[10] Wallesch Virchows Archiv, 251, No 107, 1924
[11] Lowenhardt Deutsch Med Wchnschr, 49, 1923
[12] Busse Virchows Archiv, 229, 1921
[13] Herz Deutsch Med Wchnschr, Bd 5, No 21, 956, 1909
[14] Reinhardt Mitteil a d Grenz d Med u Chir, 26, 432, 1913
[15] Lebert Berl Klin Wchnschr, 1866
[16] McKinney, Acree, and Stoltz Bull N Y Neur Instit, 5, 247, 1936
[17] Cushing, H, and Bailey, P Tumors Arising from the Blood Vessels of the Brain C C Thomas, 1928
[18] De Martel, Th, and Guillaume, J Les Tumeurs Cerebrales Paris, 1931
[19] Borchardt (ref Smidt, Hans) Aneurysmen der Hirnarterien, etc, in Krause Die Spezielle Chirurgie der Gehirn Krank, 1, 681–684, 1930
[20] Adams, J Lancet, 2, 768, 1869
[21] Foix Cavernous Syndrome Bull et Mem Soc Med d Hop de Paris, 34, 1355–1361, 1920
[22] Moller, P Zentralbl f d ges Chir, 5, 518, 1921
[23] Symmonds, C P Guy's Hosp Reports, 73, 139, 1923
[24] Bramwell, E Trans Ophthal Soc Lond, 54, 205, 1934
[25] Jefferson, Geoffrey Compression of the Chiasma, Optic Nerves and Optic Tracts by Intracranial Aneurysms Brain, 60, Pt 4, 444–497, 1937
[26] Trevani Deutsch Zeitscft f Chir, 237, 534, 1932
[27] Sossman and Vogt Amer Jour Roentgenol, 15, 122, 1926
[28] Abl Fortschr f d geb d Roentgenotrahl, 39, 890, 1929
[29] Wakely Med Press and Circ, 194, 337, 1937
[30] Sjoquist Nervenartz, 238, 1936
[31] DeVet and Zeckel Med Tijdschr v Geneesk, 81, 4145, 1937
[32] Loman and Myerson Jour Nerv and Ment Dis, 83, 583–587, 1936
[33] Olivecrona Deutsch Zeit f Nervenheilk, 1932
[34] Lindblom Acta Radiologica, Suppl, 30, Stockholm, 1936
[35] Lindon, L C E Med Jour Austral, 1, 849–853, 1936
[36] Kobck, H Deutsch Med Wchnschr, 62, 1874–1915, 1936
[37] Sai and Constantinides Revist Neurolog, 5, 449–470, 1932
[38] Lohr Archiv f Clin Chir, 186, 298–316, 1936,
Idem Zentralbl f Chir, 63, 2593, 1936,
[39] Lohr and Jacobi Klin Wchnschr, 27, 1006, 1934,
Idem Klin Wchnschr, 31, 1137, 1934
[40] Saito, Makato, and Kamikawa, K Amer Jour Surg, 17, 16, 1932
[41] Reboul, H L'Arteriographie des Membres et de l'Aorta Abdominale Masson et Cie, 1936

[42] Arteries, Roentgenography Fourth Series, Index Catalogue, Army Medical Library, Washington, 1, 767–768, 1936
Brain, Blood Vessels, Angiography (Arterial Encephalography) Fourth Series, Index Catalogue, Army Medical Library, Washington, 2, 839, 1937
[43] Northfield and Russell Lancet, 1, 377–381, February 13, 1937
[44] Horsley, quoted by Beadles, C F Aneurysms of the Large Cerebral Arteries Brain, 30, 321, 1907
[45] Keen, W W Med News, N Y, 57, 443, 1890
[46] Magnus J A M A, 88, 1712–1713, May 28, 1927
[47] Veits Jour Nerv and Ment Dis, 47, 12, 1926
[48] Packard and Zabriskie J A M A, 85, 1633, 1925
[49] Dott, Norman Edinburgh Med Jour, 219, 1933
[50] Moniz, Egaz Angiographie Cerebrale Paris, 2nd Ed, 230–246, 1934
[51] Tonnis, W Zentralbl f Chir, 844, 1934
[52] McKendree and Doshay Bull N Y Neurol Inst, 5, 223, 1936
[53] Walsh and Love Proc Staff Meet, Mayo Clinic, 12, 81–88, February 10, 1937
[54] Forbus, W D Johns Hopkins Bull, 47, 230–284, 1930
[55] Zeller, O Deutsch Zeitft f Chir, 3, 1, 1911
[56] Hamby, W B, and Gardner, W J Archiv of Surgery, 27, 676, 1933
[57] Charcot and Bouchard Oeuvres completes de J M Charcot, IX, Paris, 1887–90
[58] Lindau, A Acta Opthalmologica, Kobenhag, 4, 193–226, 1927
[59] Von Hippel, E V Graeffe's Arch f Ophth, 79, 350–377, 1911
[60] Travers, B Med a chir Trans, 6, 632, 1815
[61] Duret, H Jnl Soc Med Lille, 2, 193, 217, 1892
[62] Cushing, H Keen's Surgery, 3, 215–218, 1909

BRAIN ABSCESS DUE TO GAS-FORMING, SPORE-BEARING ANAEROBES

REPORT OF TWO CASES, WITH RECOVERY

CHARLES BAGLEY, JR., M.D.

BALTIMORE, MD

FROM THE DEPARTMENTS OF PATHOLOGY AND NEUROSURGERY, UNIVERSITY OF MARYLAND MEDICAL SCHOOL, BALTIMORE, MD

THE organism commonly known as the gas bacillus was described by Welch and Nuttall, in 1892,[1] as the *Bacillus aerogenes capsulatus*. A few months later Fraenkel[2] described four cases of gaseous phlegmon in which he found an anaerobic gas-forming bacillus. In three of them other bacteria were found, chiefly pyogenic Cocci. Fraenkel called his bacillus the *Bacillus phlegmones emphysematosae*, and his description corresponds very closely with the characteristics of the *Cl. aerogenes capsulatus*. In the German literature the organism is frequently called the Fraenkel or Fraenkel-Welch bacillus.

The organism is one of the Clostridium group of bacteria which are large-sized, spore-forming rods and are anaerobic or micro-aerophilic. The group is comprised of over 100 members, but there are only eight which are pathogenic for man. An important member in the group is *Cl. tetanus*, but in pure culture gas formation is not an important characteristic. *Cl. botulinum* produces food poisoning and is not known to be a factor in putrefactive wounds. The remaining six, *Cl. perfringens*, *Cl. oedematis*, *Cl. oedematis maligni* (*vibrion septique*), *Cl. fallax*, *Cl. sporogenes*, and *Cl. aerofetidum*, are described by Jordan[3] as "the anaerobic agents of the gaseous infections." Aerobic bacteria may produce phlegmonous type of wound infection, but in 126 cases of gaseous wound infection reported by Weinberg and Séguin,[4] no case of gas gangrene was observed to be due to aerobes alone. Organisms of the Clostridium group are occasionally found in brain abscess. If gas is present in the wound, it is due to the presence of anaerobes, since it is only in their presence that other bacteria may augment gas production. From the standpoint of gas formation, *Cl. welchii* is by far the most important member of the Clostridium group. It occurs roughly in between 70 and 80 per cent of cases of gas gangrene, either alone or together with other anaerobes.

Gas phlegmon had been observed before the description of the organism by Welch and Nuttall. No attempt will be made here, however, to give a historic review. An excellent one has been published by Millar,[5] who believes, from the writings of Hippocrates and Celsus, that they perhaps saw patients of this type, but after this there was apparently a long period during which the disease was not recognized. From the middle of the eighteenth century, however, he cites a number of authors and states that at a meeting of the Academy of Sciences, October 11, 1849, Chassaignac asserted that certain gangrenes with emphysema should be considered as having "a poison far in excess of

the mechanical injury" Millar then states that Maissoneuve, in 1853, reported two cases of gas gangrene, and stated that there existed a certain variety of traumatic gangrene to which he gave the name of *"gangrene foudroyante,"* in which, first, putrefying gas developed in the interior veins during life, and second, that this gas circulated in the blood and caused a fatal poisoning Millar mentions that cases were reported during the Crimean War (1854–1856), but that Keen, who served as a military surgeon, stated that he never saw an instance in the American Civil War



FIG 1.—Photograph of sections through the brain of a patient who died 24 hours after severe cervical cord injury The specimen was removed 19 hours after death In the smooth walled cavities the *Cl aerogenes capsulatus* was found Differentiation between the smooth walled gas filled cavity in this type of postmortem specimen (Swiss cheese brain) from the necrotic pus and gas filled cavity of a true antemortem abscess is not difficult

The description of the Clostridium by Welch and Nuttall, however, marked the beginning of a period of intensive study of the condition The early studies were confused by the fact that there is commonly a spread of the gas bacillus from the intestinal tract to all parts of the body shortly after death, and even to-day any review of the literature is greatly complicated by this fact, so that one is perhaps not justified in concluding that the bacillus played a rôle in the formation of an abscess unless gas was known to be present in the abscess during life, and the cultures from which the bacteriologic studies were made

were taken before death The formation of gas-filled cavities in the brain postmortem, producing what is commonly called a Swiss cheese brain (Fig 1), must not be confused with anatomic antemortem changes The condition is due to a gas bacillus, frequently the *Cl aerogenes capsulatus*, and is very common unless the autopsy is performed immediately after death, or the body is kept at a very low temperature

There is little difficulty in differentiating the smooth-walled cavity in this type of brain from the pus-filled, necrotic cavity in the true antemortem gas bacillus infection Reuling and Herring[6] described such a case, in 1899, and concluded that the changes were postmortem Howard[7] followed with other cases, and though it was his opinion that the process was a postmortem one, one of his cases is often quoted as a gas bacillus brain abscess This is perhaps due to the fact that the patient did have a metastatic brain abscess with meningitis, but the gas-filled cavities were separate from the suppurating cavity and the author states that in his opinion the gas cavities were due to postmortem changes In the Mackay[8] report there is a photograph of the brain which leaves no doubt concerning the postmortem development of the gas cavities

After a fairly careful search of the literature there have been collected 21 cases of gas bacillus infection in the brain, which have been placed in four groups based upon the clinical, bacteriologic, and postmortem findings

In the first group have been included those cases in which there was clinical evidence of infection and the *Cl aerogenes capsulatus* was identified in cultures made before death In this group there are five cases two by Rychlik,[9] in 1916, one by Wolfsohn,[10] in 1918, one by Pettermand,[11] in 1927, and one by Maxwell,[12] in 1930 The cases of Rychlik and Pettermand recovered, the other two cases died Of the two cases reported herein, one falls into this group The cultures showed *Cl aerogenes capsulatus* and *Streptococcus hemolyticus* The patient recovered

The second group includes cases in which there was clinical evidence of gas bacillus infection, but there was either no bacteriologic study, or if there was, no identifiable member of the Clostridium group was cultured von Heyde,[13] in 1908, described a patient with a brain abscess who died after an illness of a month He does not mention gas being found in the abscess, but in the cultures an anaerobic gas bacillus, not pathogenic for animals, was recovered This is thought to be the first case appearing in the literature in which a gas-forming organism was considered to play a rôle in the formation of a brain abscess Tietze and Korbsch,[14] in 1915, reported a clinical case and stated that even in the absence of a bacteriologic study they considered it one of gas bacillus infection of the brain Bier,[15] in 1916, reported a case in which bubbles of gas were seen exuding from the head wound The patient died five days after the injury and an autopsy was performed shortly after death by von Aschoff, who identified an organism assumed to be the *Cl aerogenes capsulatus*, though no cultures were made von Ritter,[16] in 1916, in discussing gas gangrene, stated that he had seen the condition in the brains of four

patients He gives a short description of the clinical course in such cases, but no bacteriologic studies were made Jakobsohn,[17] in 1917, reported the case of a man who had an arm wound with gas infection and also a head wound from which gas escaped on exploration There is no mention of bacteriologic studies, but Jakobsohn considered it a mild gas bacillus infection from which the patient recovered Wolf,[18] in 1917, reported a case of gas infection of the brain with death in 24 hours Again there was no bacteriologic study Dandy,[19] in 1926, reported a case of temporal lobe abscess secondary to mastoiditis The abscess was drained, and from it escaped a large amount of gas He concluded that the gas was not of bacterial origin, but was air which had been forced through the mastoid wound into the abscess by swallowing, coughing, or sneezing There is no record of bacteriologic study of the pus from the brain abscess, but that obtained from the antrum of the mastoid and from an extradural abscess showed *B coli*, *Staphylococcus albus*, and *pneumococcus* Type IV The same author, in a later publication,[20] stated that the *B coli* was probably the organism responsible for the production of the gas This patient died In 1927, Dandy[21] reported another case In this the organism was a gram-negative bacillus which was nonmotile, nonspore-bearing, and did not grow aerobically There was also a growth of *Streptococcus viridans* in cultures from the abscess This patient recovered

Of the 11 cases in this group, nine died and two recovered The second case herein reported falls into this classification An anaerobic gas-forming bacillus, probably *Cl welchii*, but not grown in pure culture, was present together with a heavy growth of *Staphylococcus aureus* This patient recovered

The third group includes cases in which there was a clinical diagnosis of gas bacillus infection in the brain with positive gas bacillus cultures postmortem Hixon,[22] in 1915, reported an autopsied case in which the *Cl aerogenes capsulatus* was isolated in pure culture from pockets of pus in the brain tissue This patient had a shrapnel wound of the brain and the autopsy was performed one hour after death No clinical description was given Marwedel,[23] in 1917, reported the case of a man with a head injury who died eight days after admission An autopsy was performed the following day The diagnosis of brain abscess was made before death, but the abscess was not located at operation At autopsy, however, a left frontal lobe abscess was found, and in cultures made at this time the *Cl aerogenes capsulatus* was recovered, together with *Streptococci*, *B coli*, and other organisms This cannot be accepted as an antemortem gas infection, as the autopsy was not performed until the day following death Schar,[24] in 1928, reported a case of brain abscess secondary to a skull fracture At the operation a large amount of pus, soft brain tissue, and foul gas were evacuated In cultures taken at the autopsy there was an unclassified bacillus which grew aerobically and anaerobically, and was definitely gas-forming Durck,[25] in 1930, reported a case in which a gas bacillus was found in the brain, liver, spleen, kidney, and heart four hours after death This patient, 13 years previously, had sustained a depressed fracture in the right frontal region and bone fragments were projecting into the cortex The

autopsy revealed a cavity beneath the depressed fragments which contained grayish-brown, bloody pus The author concluded that the bacillus had remained dormant since the injury 13 years previously and for some unknown reason became active in the brain and spread to other tissues of the body One finds it difficult to agree with this conclusion and even the bacteriologic findings must be questioned in a case autopsied four hours after death

There is but one case in the fourth group, that of Mill and Papplewell,[26] reported in 1931, in which there was a large extradural abscess complicating a mastoiditis Cultures made at the time of operation showed vibrion septique There is no mention, however, of the finding of gas in the abscess cavity or in the brain at autopsy The lateral sinus, the superior and inferior petrosal sinuses on the operated side, and both cavernous sinuses contained pus, but no mention was made of gas in them or of a bacteriologic study of their contents

The appended two cases are the only ones that have come under my personal observation The second one was seen about two and one-half years after the first one The relatively small number of cases in the literature indicates either that gas-forming organisms are infrequently a causative factor in the formation of brain abscess, or that the condition is overlooked by the surgeon Invasion by the gas bacillus in other tissues of the body is, of course, a serious condition, and we were very pessimistic regarding the prognosis in the first case The chief difficulties in this patient, however, were due to increased intracranial pressure and the patient's condition rapidly improved after the drainage of the thin, bloody pus and the evacuation of gas In both of the patients there seemed to be no further extension of the gas into the brain tissue, in spite of the fact that there was a growth of the gas bacillus in the cultures of the pus from the wound in the second case at the end of almost three weeks

Case 1—PUNCTURE WOUND, LEFT TEMPORAL REGION HEADACHE, APHASIA, AND MENTAL CONFUSION DEVELOPING OVER PERIOD OF ONE WEEK DRAINAGE OF ABSCESS AND EVACUATION OF GAS *Clostridium welchii* IN PURE CULTURE RECOVERY

Case Report—C S, white, male, farmer, age 42, was admitted to the University Hospital, Baltimore, January 21, 1935, in a semistuporous condition One week previously he had been thrown against the stall in a stable and a projecting 8-penny nail was driven into his head on the left side just above the ear There was profuse bleeding with momentary loss of consciousness In a few moments he walked into the house and went to bed for a short time, but then got up, feeling well The next morning he called his doctor Two days later he noticed difficulty in talking, which became progressively worse and was accompanied by mental confusion From that time on he became markedly aphasic The evening before admission he became drowsy and confused

Physical Examination revealed that the patient was very drowsy and though he could be aroused, immediately lapsed back into a stupor He was unable to carry out simple commands, such as opening and closing the hand, and could not name common objects Temperature, 101 1° F rectally, pulse, 64, respiration, 30 There was slight

obscuration of the nasal border of both optic disks, but no measurable edema, hemorrhage, or exudate was noted The left pupil was dilated and reacted sluggishly to light The right was also sluggish, but smaller There was slight weakness of the right side of the face, and slight weakness of grip in the right hand The lower extremities were normal in power The right biceps and left abdominal reflexes were hyperactive, while the right abdominal reflexes were hypo-active All the other reflexes were present and active There was an area of swelling above the left ear, with edema around the edges and fluctuation in the center

Operation—Exploration revealed a small puncture wound of the skull and an extradural cavity from which pus and foul-smelling gas were evacuated There was a healed rent in the dura The extradural cavity was drained with the hope that the neurologic disturbances had been due to the extradural accumulation of pus Smears of the pus showed a gas bacillus which later proved to be the *Cl aerogenes capsulatus* (Fig 2),

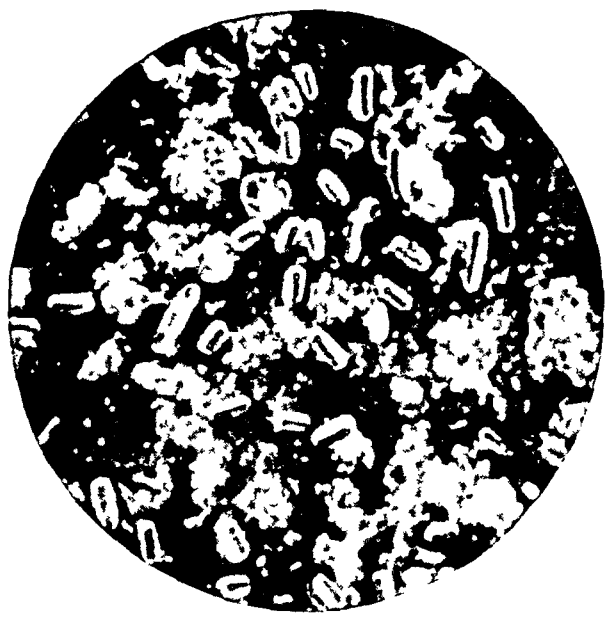


FIG 2—(Case 1) Microphotograph showing the encapsulated *Cl welchii* obtained in pure culture from the pus of the abscess (× 1250)

together with a heavy growth of *Streptococcus hemolyticus* The guinea-pig inoculated became distended with gas and died in a few hours Following the operation the patient improved for four days, after which time the original symptoms returned and it was concluded that there was cerebral involvement The original incision was reopened and the healed perforation in the dura exposed and enlarged Through a ventricular needle several cubic centimeters of bloody pus escaped, together with a large amount of foul-smelling gas Two split, Dakin drainage tubes were inserted

Subsequent Course—The patient improved rapidly, so that four days later, while not oriented as to place, he was able to give a very coherent account of the accident The aphasia gradually disappeared During the dressing on the twentieth day, gas bubbles were seen escaping with the pus The neurologic signs rapidly disappeared and the patient was discharged March 3, 1935, 40 days after operation There was still a small amount of drainage from the tubes which were gradually shortened but allowed to remain in place until drainage had ceased, almost three months later Even before the removal of the tubes the patient was attending to a part of his duties and he has remained entirely well since

In the second case the patient was admitted four days after an injury There was satisfactory progress after drainage of the abscess until 45 days after the accident when the patient suddenly developed tetanus which ran a very stormy course over a period of three weeks He had been given 20,000 units of combined tetanus-gas gangrene antitoxin immediately following operation on the fifth day after the accident It has recently been our practice to follow the advice of Cole and Spooner[27] and give 200,000 units of antitoxin as soon as a diagnosis of tetanus is made Because this patient was sensitive to serum, it was necessary to administer the antitoxin over a period of seven days, and the number of units was increased to 300,000 Débridement of the wound was not possible, although the original drainage tubes were still in the abscess and through them there was free drainage of pus

Case 2—COMPOUND DEPRESSED FRACTURE, LEFT PARIETAL REGION IMMEDIATE PARTIAL RIGHT HEMIPLEGIA EVIDENCE OF SUPPURATION REMOVAL OF BONE FRAGMENT DRAINAGE OF ABSCESS AND EVACUATION OF GAS, FIVE DAYS AFTER INJURY SEVERE TETANUS BEGINNING FORTY-FIFTH DAY AFTER ACCIDENT RECOVERY

Case Report—L G W, white, male, age 11, was admitted to the Union Memorial Hospital, Baltimore, during the night of June 21, 1937, four days after being struck on the left side of the head with a heavy stick At the time of injury he felt faint, but did not lose consciousness There was an immediate right hemiplegia He was taken to a local hospital where a two and one-half centimeter laceration of the scalp in the left parietal region was sutured He complained of severe headache and abdominal pain, followed by vomiting That night there was an elevation of temperature He began to use his right leg again but his arm remained paralyzed The next morning he vomited again and that evening seemed worse, with higher temperature, irritability, and pain Four days after the injury he was transferred to the Union Memorial Hospital

Physical Examination—Revealed a weak and inactive, but fully conscious and well oriented young boy Pus was exuding from the laceration of the scalp Temperature, 101° F, pulse, 74, and respiration, 14 The neurologic examination revealed partial, right hemiplegia with absent knee jerk and positive Babinski Sensory perception was normal Uranalysis, negative Blood white blood cells, 21,600, hemoglobin, 92 per cent Roentgenologic examination of the skull showed a small, depressed fracture of the left parietal bone and a gas shadow extending downward into the left cerebral hemisphere (Fig 3)

Operation—June 22, 1937 The depressed fragment of bone was removed The dura and cortex in this region were lacerated There was a free escape of pus and foul-smelling gas when the fragment was withdrawn from the cortex Two small Dakin drainage tubes were inserted

Subsequent Course—Following the operation 20,000 units of combined tetanus-gas gangrene antitoxin were given and 20 grains of sulfanilamide prescribed every four hours The latter was reduced to ten grains every four hours the following day, and 10,000 units of the antitoxin were also given

Culture of the pus taken from the wound revealed an anaerobic gas-forming bacillus, believed to be the *Cl aerogenes capsulatus*, but it was not identified beyond doubt, together with a heavy growth of *Staphylococcus aureus*

The patient improved for several days following the operation, during which time he developed a red, macular sulfanilamide dermatitis and the leukocyte count fell to

5,000, and the hemoglobin 64 per cent The sulfanilamide was discontinued July 2, and the leukocyte count in two days rose to 12,000 During the next several weeks sulfanilamide was given cautiously from time to time because of the free drainage of pus through the tubes and the positive cultures for gas bacilli until the nineteenth day On July 24, there was still a profuse discharge of pus from the abscess cavity and some evidence of osteomyelitis in the area surrounding the skull defect

On August 1, 45 days after the accident, the patient developed signs of tetanus Temperature, 102° F , pulse, 160, respiration, 26 The symptomatology in the beginning was stiffness of the jaws and rigidity of the abdominal muscles Within a few hours the patient had several convulsive seizures He was given 300,000 units of tetanus antitoxin over a period of seven days, when its administration was discontinued During

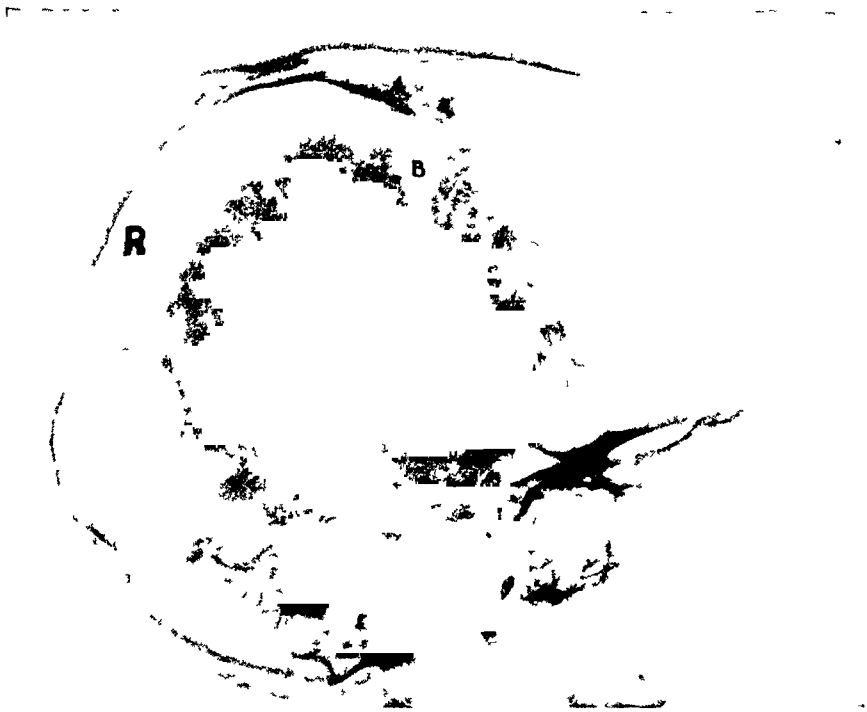


FIG 3 —(Case 2) Lateral roentgenogram of the skull showing a small depressed fragment of bone (full thickness of skull) at A, and a single large bubble of gas at B

this time the boy was extremely ill During the seven-day period in which the antitoxin was given, avertin was administered in an average daily dose of 50 mg per kilo of body weight to control the convulsions After this period an occasional dose of avertin was sufficient For about three weeks the condition was grave, after which there was a very satisfactory improvement Four weeks after the onset of the tetanus, the muscular spasm had ceased The abscess drainage tubes were removed six weeks after the operation There was some drainage of pus for three weeks following After this time the wound healed entirely

On September 24 the patient was out of bed and began to walk At this time there was a typical hemiplegic gait He was taken over by the Physiotherapy Department, and when discharged from the hospital, October 3, 1937, the deep reflexes of the right side were hyperactive, there was moderate knee and ankle clonus on the same side, and the Babinski was equivocal There was still muscular weakness in both right upper and lower extremities Since discharge there has been a gradual return of function, so that there is now only slight evidence of the previous hemiplegia

Discussion.—In Case 1 there was an interval of one week between the injury and the date of admission to the hospital. During this period the patient gradually developed evidences of focal disturbance in the left hemisphere. It is unlikely that the abscess was well walled-off, first, because of its short duration, and second, because the pus which escaped at operation was of a thin, bloody type. In spite of this, however, drainage was free following the operation and there was a rapid disappearance of intracranial pressure, as well as of the signs of sepsis. The clinical diagnosis was made at operation by the escape of foul-smelling gas which was evidenced by numerous bubbles in the pus. Cultures showed *Cl. aerogenes capsulatus* and hemolytic *Streptococci*. Immediately after the operation tetanus-gas gangrene antitoxin was given, but after the laboratory findings were known, gas antitoxin alone was given. No sulfanilamide was used in this case.

In Case 2 there was an interval of five days between the accident and the operation. Gas gangrene antitoxin was given, but only in the beginning of the course. The cultures were positive until the nineteenth day. Sulfanilamide was used over a period of several weeks in this case. In spite of a prophylactic dose of tetanus antitoxin five days after the accident, tetanus developed on the forty-fifth day, and not withstanding the long interval the course was severe.

One might ask what measures were valuable in controlling the gas bacillus infection in these cases. The answer would seem to be drainage, plus the possible effect of rather small doses of gas antitoxin in both cases and the use of sulfanilamide in the second case. Roentgenotherapy was considered but not employed in either case because of early improvement in the condition of the patients.

SUMMARY

(1) A review of the literature reveals only five cases of brain abscess in which there was clinical evidence of gas formation with the bacteriologic identification of the *Cl. aerogenes capsulatus* in the antemortem cultures. Of these, three recovered and two died.

(2) An additional case which falls into this group is herein reported, which recovered.

(3) The literature reveals 11 cases in which there was clinical evidence of gas bacillus infection, but in which there was either no bacteriologic study, or if there was, no identifiable member of the Clostridium group was grown. In this group nine died and two recovered.

(4) An additional case of this type is reported, which recovered. The course in this patient was greatly complicated by the development of tetanus on the forty-fifth day after the accident.

(5) In the third group are cases in which there was a clinical diagnosis of gas bacillus infection in the brain with positive cultures postmortem. Four cases of this type have been collected from the literature.

(6) A fourth group includes one case in which the *Cl oedematis maligni* (vibrion septique), an important organism of the Clostridium group, was grown in cultures from an extradural abscess following operation This patient died

(7) The treatment of gas bacillus abscess of the brain is discussed

REFERENCES

[1] Welch, W H, and Nuttall, G H F A Gas-producing Bacillus (Bacillus Aerogenes Capsulatus, Nov Spe) Johns Hopkins Hosp Bull, 3, 81–91, 1892

[2] Fraenkel, E Ueber die Aetologie der Gasphlegmon (Phlegmone Emphysematosa) Centralbl f Bakteriol u Parasitenk, 13, 13, 1893

[3] Jordan, E O A Textbook of General Bacteriology, pp 399–400, 4th ed, W B Saunders Co, Philadelphia, 1928

[4] Weinberg and Seguin La Gangrene Gazeuse Paris, 1918

[5] Millar, W M Gas Gangrene in Civil Life Surg, Gynec, and Obst, 54, 232–238, February, 1932

[6] Reuling, R, and Herring, A P Cavities in the Brain Produced by the Bacillus Aerogenes Capsulatus Johns Hopkins Hosp Bull, 10, 62, 1899

[7] Howard, W T, Jr A Contribution to the Knowledge of the Bacillus Aerogenes Capsulatus Johns Hopkins Hosp Rep, 9, 461, 1900

[8] Mackay, M A Brain Containing Gas Cyst of Microbic Origin Montreal Med Jour, 32, 795, 1903

[9] Rychlik, E Gasabszess des Gehirns Munch med Wchnschr, 63, 1713–1714, 1916

[10] Wolfsohn, G Bericht uber 100 Falle von Gasodem Beitr z klin Chir, 112, 560–580, 1918

[11] Pettermand, A Gasbrandinfektion des Gehirns Deutsche Ztschr f Nervenh, 96, 70–84, 1927

[12] Maxwell, V W Brain Abscess from Aerogenes Capsulatus Infection, Case Radiol, 15, 693, December, 1930

[13] von Heyde Zur Bakteriellen Aetiologie und Klinik des Hirnabszesses Deutsch med Wchnschr, 34, 2214–2217, 1908

[14] Tietze and Korbsch Zum Kapitel der Gasphlegmone (Gasphlegmone der Pia Mater) Deutsche med Wchnschr, 41, 340, 1915

[15] Bier Anaerobe Wundinfektion (abgesehen von Wundstarrkrampf) Beitr z klin Chir, 101, 271–335, 1916

[16] von Ritter Ueber Gasbrand Beitr z klin Chir, 98, 47–72, 1916

[17] Jakobsohn, E Einiges uber Gasphlegmone und Gasgangren Deutsch med Wchnschr, 43, 685–687, 1917

[18] Wolf, W Die Behandlung der Schadelschusse im Feldlazarett Munch med Wchnschr, 64, 469–471, April 3, 1917

[19] Dandy, W E Pneumocephalus (Intracranial Pneumatocele or Aerocele) Arch Surg, 12, 949–982, 1926

[20] Dandy, W E Aerogenic Abscess of the Brain In Dean Lewis' *Surgery*, 12, 383 W F Prior Co, Hagerstown, Md, 1932

[21] Dandy, W E Pneumocephalus of Bacterial Origin Arch Surg, 15, 913, 1927

[22] Hixon The Gas Bacillus in a Brain Injury Brit Med Jour, 2, 905, December 18, 1915

[23] Marwedel, G Uber offene und ruhende Gasinfektion Deutsche med Wchnschr, 43, 771–774, 803–806, 836–840, 1917

[24] Schar, W Gehirngasbrand Deutsche Ztschr f Chir, 211, 414–417, 1928

[25] Durck, H Uber 13 Jahrelang ruhende Gasodeminfektion nach Schussverletzung des Gehirns Beitr z Path Anat u z Allg Path, 84, 667–678, May 30, 1930

[26] Mill, W A, and Papplewell, J R F Mastoid Infection by Clostridium Septique Complicated by Thrombosis of Cavernous Sinuses, Case Jour Laryngol and Otol, 46, 618–621, September, 1931

[27] Cole, L, and Spooner, E T C Treatment of Tetanus, with Observations on the Fate of Injected Antitoxin Quart Jour Med, n s, 4, 295–319, 1935

DISCUSSION —DR THOMAS S CULLEN (Baltimore, Md) —It may be of interest, in connection with Doctor Bagley's paper, to recall the report of the first case of gas bacillus infection, which was presented by Drs William H Welch and George H F Nuttall

The patient, a colored man, age 39, was admitted to Doctor Osler's service at the Johns Hopkins Hospital, October 24, 1891, and died the following day A gas-producing bacillus was isolated During the subsequent months I followed Doctor Welch's and Doctor Nuttall's study of this organism with great interest Their full report appeared in the Johns Hopkins Hospital Bulletin for July–August, 1892

In 1893, George Nuttall, Simon Flexner and I went abroad together Nuttall lived for several years in Germany, later on he made England his home and became an outstanding professor in Cambridge University In 1912, he returned to Baltimore to give the Herter Lectures at the Hopkins Medical School On that occasion we got out a historic number of the Johns Hopkins Hospital Reports It was dated October 9, 1912 Max Broedel made a cartoon showing "The Welch-Nuttall Gas Plant" The trunk of the tree was made up of large gas bacilli, the branches of smaller ones, and so on down to the finer twigs On the ends of the twigs were gas bubbles which Cupid was lighting

THE USE OF FASCIA AND RIBBON CATGUT IN THE REPAIR OF CLEFT PALATE AND HARELIP

ADDISON G BRENIZER, M D
CHARLOTTE, N C

ALMOST all harelip, cleft alveolar process, and cleft palate cases are deficient only in hard palate and not in bony, muscle and fibrous tissue, which can be used to close them, though these structures may be retracted and atrophic

The objective point in the operations is to restore the normal configuration, liberate and reunite the soft parts, disturbing muscle origins and insertions as little as possible, except the binding of the tensor palati and palatopharyngei muscles at the hamular process, and through counter incisions allow the whole flap, containing the muscles, to slip inward and backward There, they are to be united in the midline without tension on the line of suture

These conditions can be attained through the rationale or principle of the so-called Langenbeck operation and its modifications, particularly those of Veau and Dorrance

The refinement of Victor Veau, when accomplished, is a more finished operation and likewise more difficult and time-consuming In very wide clefts and in double clefts, particularly, where a bed for the buccal flaps, sometimes pedicled, is desired, the union first in sequence of the nasal mucoperiosteum offers a support and blood supply to the buccal flaps and an upper covering for them The covering of the raw upper surface of the buccal flaps not only preserves them as cut and placed and prevents granulations and scar contraction, but establishes both closed mucous membrane lined buccal and nasal cavities While the nasal mucoperiosteum is rather easily separated, it is not so easily displaced and sutured in its entirety

The Dorrance "push-back" operation is extensive, severing both anterior and posterior palatine arteries, requires two operations for the reestablishment of collateral blood supply, and it is difficult to maintain the flaps, off the hard palate, in position Lateral incisions encircling the posterior extremity of the maxillary alveolar process and extending backward and downward over the pterygomandibular fold and through them, liberation of the hamular process and the attachment of the nasal mucoperiosteum to the hard palate, suffice in the displacement of the velum inward and backward and the union of the hamular insertion of the palatopharyngei, a portion of the constrictor pharyngei By such a liberation of flaps alone, in the large majority of cases, when the musculature of the velum and pharynx are exercised, the pharynx is constricted, the velum is brought against the posterior pharyngeal wall and no air escapes from the nose while speaking

Plastic operations upon the uvula are not necessary and incisions into the velum scar it and interfere with its suppleness The musculature of the velum and pharynx can be developed by the persistent use of such exercises as those described by Frederick Martin in his book on "Speech Training" A case of ours, age 30, did away with all "face-talking," and developed almost perfect speech by the unrelenting use of the exercises detailed in this book

In spite of the statements just made, there are difficult cases—cases where the flaps raised are narrow, not so yielding, cases that have been operated upon before and failed, and cases of obviously narrow flaps or double cleft where the model of the operation must be altered to meet the conditions, and

FIG 1 FIG 2 FIG 3



FIG 1 —By the use of fascial bands or ribbon catgut, placed between the mucosa and muscularis of the lips tension is taken off the suture line and the lips may be united with muscle sutures of fine cat gut and a subcuticular stitch of fine malleable wire The soft parts may be placed and maintained in proper configuration with minimum visible scarring of the lips The scarring of the mucous membrane readily repairs and is not visible The slight increase in bulkiness of the lips soon subsides

FIG 2 —Case of harelip and cleft palate where ribbon catgut was used in both lip and palate Union, configuration, and function all excellent Lip slightly bulky three weeks after operation

FIG 3 —Good union, configuration, and function in harelip and cleft palate, no surface scarring Deficient right ala and irregularity in vermilion border

simple cases still showing failures, with scarred, thickened, and unyielding flaps, presenting a real difficulty in closing These latter cases are, at times, so difficult that every effort should be made to prevent them, by assuring as far as possible the success of the first operation

It has been in cases such as suggested above, for the last 20-odd years, that we have been using a strip of fascia, taken from the fascia lata, in the form of a small rectangle, as a means to support the flaps, and relieve the tension on the stitch line from the hard palate, accompanied by a fascial tie in the musculature of the velum We had hoped for no more from this strip of fascia than (1) A transmission of the tension on the stitch line to a point beyond it and a distribution of this tension (2) A background or scaffolding for the flaps and stitch line, to hinder movements at the stitch line (3)

Fig 4

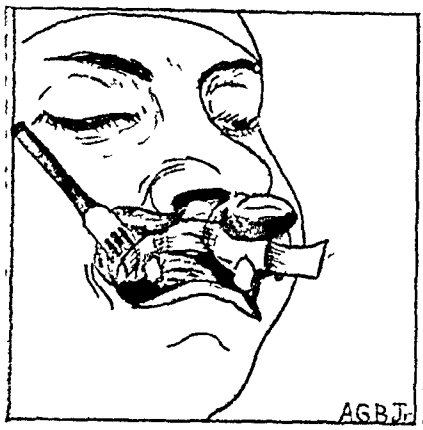


Fig 5

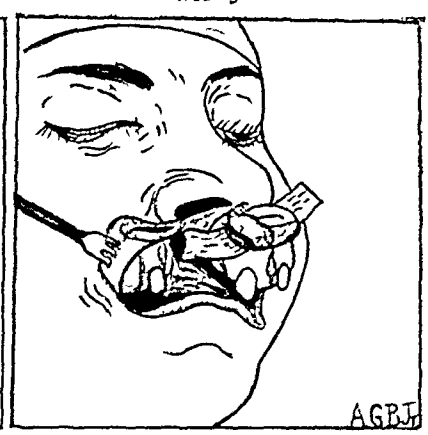


Fig 4.—Vomer premaxilla sectioned at the neck or not sectioned. Strip of fascia inserted through opening in front under mucoperiosteum of premaxilla and out and under mucoperiosteum of premaxilla and alveolar process where it is sutured. The fascial band is drawn upon tightly and attached, in similar fashion to the opposite alveolar process.

Fig 5.—*Second strip of fascia passed under philtrum between mucosa and* muscularis and stitched out into the lips on both sides between the mucosa and muscularis, pulling lips together and relieving tension on the suture line.

Fig 6

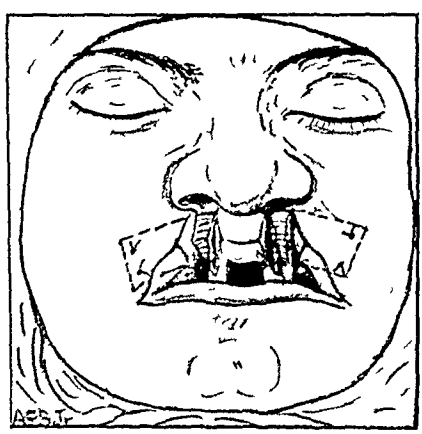


Fig 7

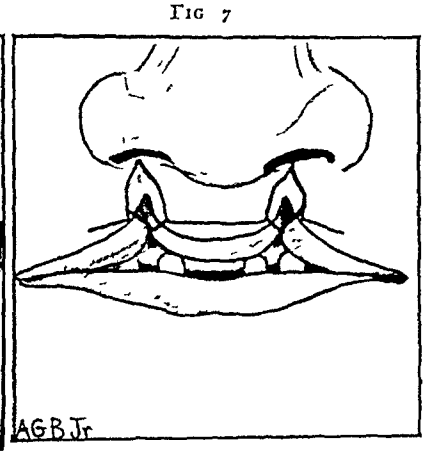


Fig 6.—*First operation performed upon double harelip using fascial band.*

Fig 7.—Pattern of second operation performed upon double harelip, where only the skin and muscularis are incised and the mucosa left intact.

Fig 8

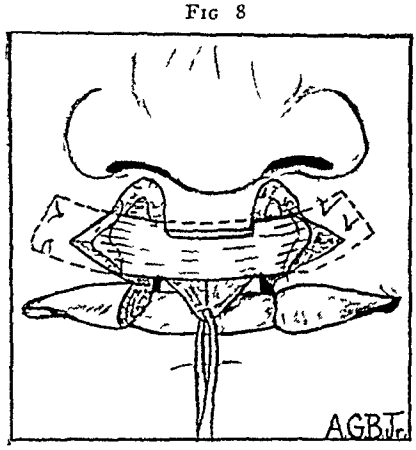


Fig 9

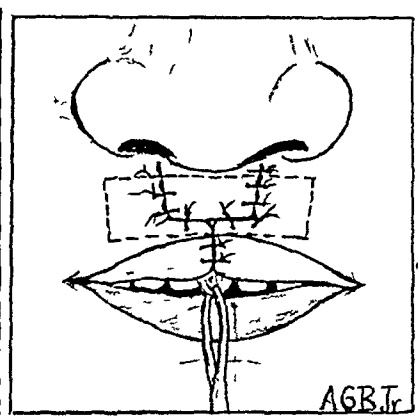


Fig 8.—A band of fascia or ribbon catgut may or may not be used in the second operation. The mucosa at the vermilion border is used to 'point up' the lip.

Fig 9.—Union of the pattern. When the band of fascia is employed, surface stitches may be avoided. Note the tip of mucosa crowning the vermilion border and "pointing up" the lip.

To act as a bumper against pressure with the tongue, vomiting, coughing, or sneezing

After serving such a purpose, and removal of the stitches in 10 to 12 days, we expected to see the fascia come away, but it did not always do so On the other hand, it remained between the bony palate and mucoperiosteal flaps, incorporated with the flaps and likely conveyed bone cells across the cleft in the hard palate, if hardness and an inability to pierce through this formerly cleft area with a sharp and pointed instrument is proof of bone

As stated, our object was not to convey periosteal cells along the fascia, spanning the gap between the edges of the cleft in the bony palate and we, also, recognized that there is some admixture of muscle, fibrous and periosteal tissue, giving toughness and hardness to the region of the hard palate even when fascia is not used, but never as definitely hard and gritty as in the two cases to be cited

Nor should we overstress the advantages of an actual bony palate over a tough, partly bony hard palate, but should stress the efficacy of the means used in the way of the fascial strip With the use of the fascial strip we have closed cleft palates which have been operated upon elsewhere and failed, or have been considered impossible to close and were about to resort to the use of a diaphragm Had these cases been merely the "run of the market," it would not be worthy of comment, because cleft palate and harelip surgery is generally bad and we have had to operate upon many of them over again, but there have been failures even in some of our very best institutions where excellent plastic surgery is performed I recall five such cases collected for us, at one time, at the North Carolina Orthopedic Hospital

Lately, we are employing ribbon catgut to replace the strip of fascia across the hard palate and embedded or tied into the musculature of the velum, and feel that it will do about as well as the fascia and, of course, offers the great advantage of being available and preventing the additional manipulation necessitated to secure the fascia from the fascia lata

There are many aids to the final closure and function of the palate, which begin with the first operation performed upon a single harelip with cleft alveolar process and particularly upon double harelip It is quite remarkable what the mere closing of the lip will accomplish in molding and bringing together a wide cleft in the alveolar process The pressure of the closed lips and its effect in narrowing and molding the alveolar process is so satisfactory that wiring, even of a double cleft, is usually unnecessary, and wiring to close the cleft palate as effected in the Brophy type of operation should be scrupulously avoided, since it is not only unnecessary, but may approach the alveolar processes too closely, narrowing the maxillary arch more than the mandibular arch, and thus establish a bad occlusion More than this, too much narrowing may cram the septum and turbinates together and cause further nasal troubles The cleft in the alveolar process may become too narrow to receive the premaxilla, because, as the pressure of the lip, or actually wiring of the premaxilla is forcing the premaxilla backward in attempting to hold it between

the alveolar processes, the narrowing of the cleft palate is having the opposite effect of pushing it back, out and forward The desired position of the premaxilla is not one far back between the two halves of the maxilla, but merely in contact and continuous with the alveolar arch Beyond these considerations, wire is a foreign body, difficult to handle and when used to pierce into bone, at least near teeth pulps, may cause extrusion of the pulps and necrosis, bringing about conditions favoring infection Over and above every other argument, wiring is usually not necessary

There are a few cases of double harelip, with markedly forward projecting and deviating premaxillae, which must be put back between the alveolar processes in order to close the lip But when it is remembered that the lips and cheeks can be widely undermined, and that they have a wide range of being stretched and adjust themselves around the oral orifice, the double clefts and projecting premaxillae can usually be covered by a two-stage operation such as is performed by Victor Veau for double harelip, or by closing one side at a time Victor Veau admits that even these cases are dependent for fixation and stability more upon the closed lip than the wiring, and if the lip does not remain closed, the premaxillae will shift and the wires loosen The premaxillae can rarely be placed and healed between the alveolar processes firmly enough to be of any use in biting Its restoration is for the plastic effect and closure of the palate, braces and plates must be employed later to assist biting and chewing

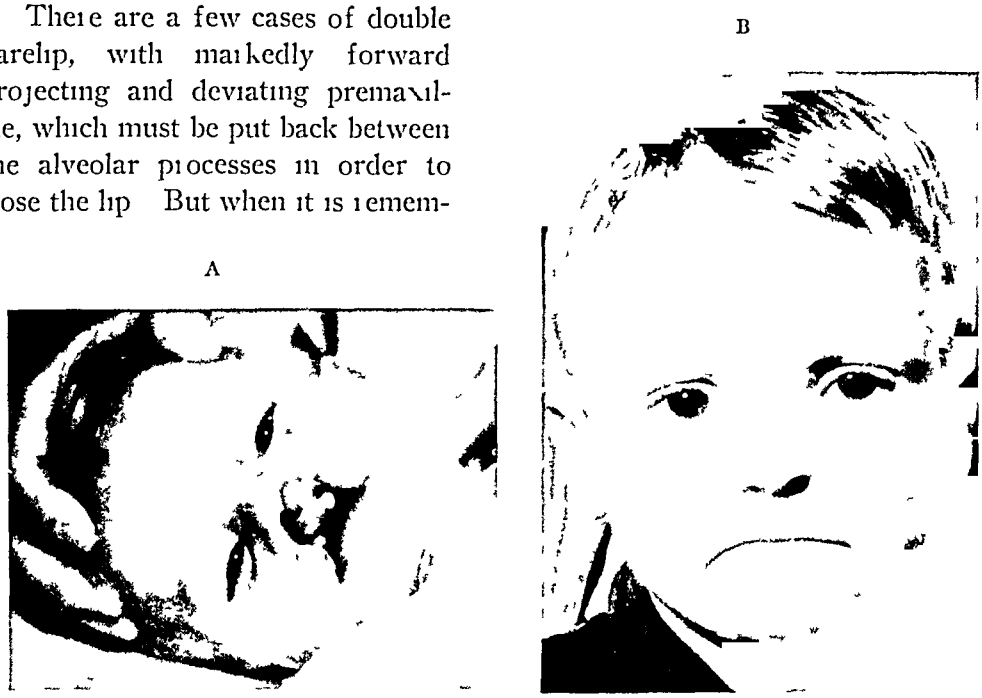


FIG 10.—(A) Double harelip markedly projecting and deviating premaxilla Diagram of fascial bands section of vomer premaxilla at neck (B) Final result



FIG 11.—Case of harelip, cleft maxilla, orbit and palate, where support and relief of tension on flaps is almost necessary

Victor Veau is quite correct in his method of sectioning the premaxilla at the neck and allowing it to slide back "like a drawer," to preserve the nasal prominence, and not hinge back, which happens when a section is removed

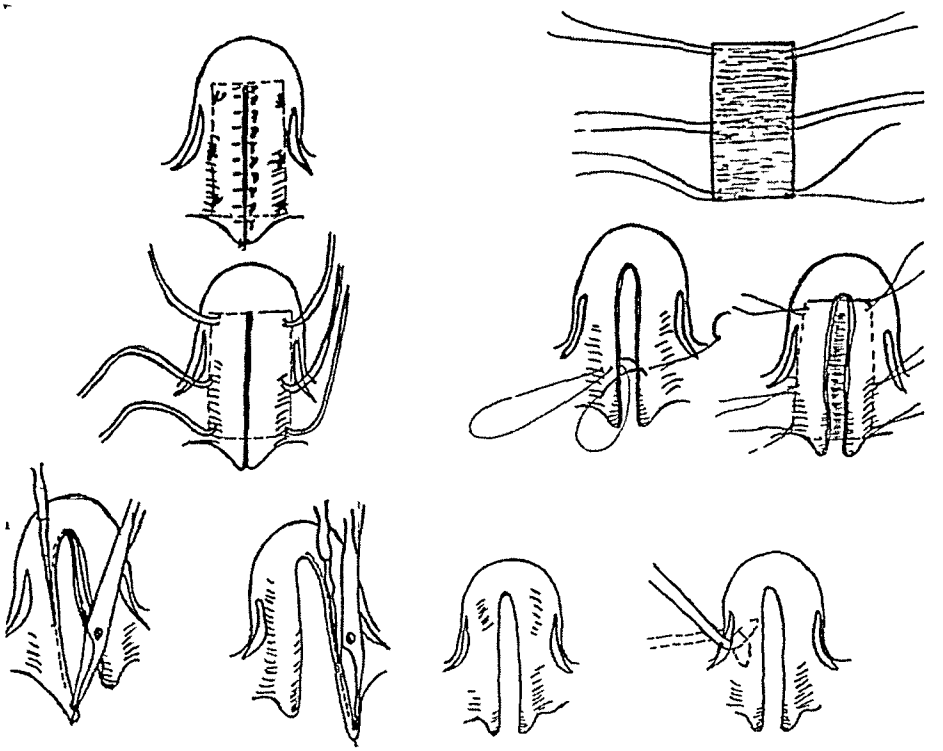


FIG 12.—The fascia first used in the cleft palate was a quadrangular strip placed in behind the mucoperiosteal flaps of the Langenbeck type of operation, or between the buccal and nasal mucoperiosteal flaps of the Victor Veau operation

FIG 13



FIG 14



FIG 13.—First case operated upon at the age of three months now 18 years old, retaining the fascial strip and showing a bony hard palate Periosteal cells conveyed across the cleft in the hard palate

FIG 14.—Second case with bony palate, following fascial implant

from the septum, as suggested by von Baideleben Both of these operations, however, loosen the one support of the premaxilla when the vomer is sec-

tioned, and makes the premaxilla more difficult to support The Veau type of sectioning at the neck does maintain the nasal prominence and vertical position of the teeth, but may loosen the premaxilla, may interfere with the anterior palatine artery, and when wires are used, may cause necrosis of the premaxilla

For holding back the premaxilla, ribbon catgut, embedded and held by stitches between the mucosa and muscularis and passing from lip to lip and under what lip there is on the premaxilla, is sufficient to relieve traction on the lips and stabilize the premaxilla until the lip heals This accomplishes everything the wires could do under the stabilizing soft parts It is interesting, not only to observe the molding and holding power of the lips upon the alveolar process and the premaxilla, but, also, the shift of tension from

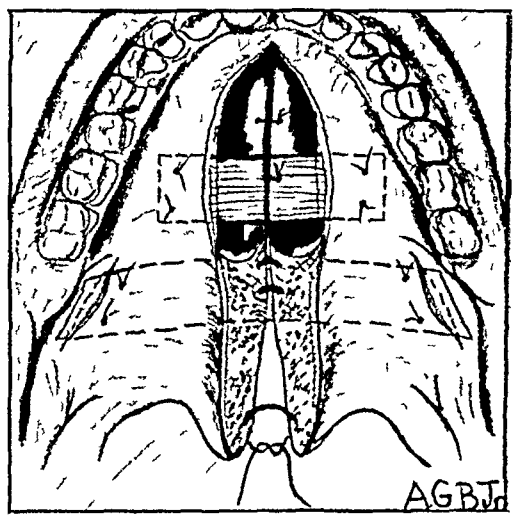


FIG 15.—Narrower strips of fascia or ribbon catgut, with a tie of fascia or ribbon catgut in the velum are now employed with good results

one lip to the other, around the mouth as it reshapens, after removal of large portions from the lip

Realizing that some stabilizing splinting of the premaxilla between the alveolar process would help hold it, particularly if the vomer were sectioned, until the lip could heal over it, and that the lips should be relieved of tension on the stitch line, we have resorted to fascia or ribbon catgut, passed under the mucoperiosteum of the premaxilla and out and under the mucoperiosteum of the alveolar processes, temporarily binding the parts together We have added to this another strip, passed under the lip of the premaxilla and out into the lip flaps on each side between the mucosa and muscularis to help press back the premaxilla, as well as to take the tension off the lip flaps Strips of fascia, as employed in the cleft palate, are somewhat better than the ribbon catgut, but ribbon catgut is readily available, and the chromisized variety will remain in position long enough to allow healing of both the contiguous

periosteal at the premaxillo-maxillary contact along the alveolar process and support the lips, which in turn mold and support the premaxilla

By the use of the fascia or ribbon catgut, between the mucosa and muscularis of the lip, we are able to take the tension off the stitch line, use subcutaneous and subcuticular stitches, and avoid those piercing the skin

The distress and chagrin, first of the parents and then of the child, when later made aware of the condition, as well as the desire to accomplish a cosmetically excellent plastic result, should direct us to attempt these operations when well prepared to perform them, with a long look ahead at the artistic and functional results

DISCUSSION.—DR. W. A. BRYAN (Nashville, Tenn.).—All surgeons who have done harelip and cleft palate work have had a great deal of trouble in obtaining closure of the palate. There is one point in connection with that that I have just found out. People who are perfectly satisfied that a child should have a large cleft, become utterly miserable if there is a small remaining perforation the size of a pencil. They are not satisfied, and occasionally consider that they should not pay the doctor because he has not completed his work.

The thing that has been most satisfactory, I think, is the most tedious thing I have ever done, but with its employment there have been no failures. That is to take a mattress suture on the nasal side of the soft palate. We perform the Langenbeck operation, but instead of paring off the edge of the cleft between the hard palate and the uvula, we split it so there will be a flap on the nasal side and one on the buccal side. I have neither used fascia nor ribbon catgut. We suture with mattress sutures. It is difficult to put the suture through and to keep from getting the threads crossed, so that when you tie it you cannot bring the flaps together. When they are put in place, they serve as retention sutures. A lot of traction is taken off the buccal mucosa, but the sutures accomplish something much more important—they close a trough that would lie in the nasal side of the line in which you expect to get union.

There is one other point in connection with the palate. These openings I speak of are nearly always in the midline and toward the front, where the cleft goes into such a narrow space that it is impossible to close it completely. Therefore you have a little hole leading from the nose to the mouth. If a flap is cut on the surface of the os incisivum coming under the point where the closure is difficult, a very satisfactory result may be obtained.

There are very few perfect results. As to the deformity of the nostril, I have been able to get a much more satisfactory closure of the nostril by making the first step of the harelip operation along the groove at the outer edge of the ala. We cut the nostril loose from the lip entirely, and when the lip is corrected the nostril can be slipped into place.

DR. WILLARD BARTLETT (St. Louis, Mo.).—Just a word about the use of fascia. After building up what we call a chair bottom, resembling the old chair seat that was built up by lacing reeds, and finding that some wounds did not run an aseptic course, and after a month or so a strand would come out, but never all of it, we came to the conclusion that absolute asepsis was not essential to the fascial strip. Three weeks ago we selected the worst possible kind of case for it, a vesicocele. All of us have attempted to close a ring

in a hernia So we used fascia, attempting to carry out asepsis but did not delude ourselves that we could keep it perfect We managed to locate the ring, and drew it together, closing with fascia The patient was discharged one week ago, and as yet no fascia has come out It will be interesting to see if it continues to remain and if we succeed in curing her vesicocele, which we have not always succeeded in doing by other methods

Dr James Barrett Brown (St Louis, Mo) —If Doctor Davis does not wish to mention it, I would like to say that his work on fascia, published in the Annals of Surgery, in 1911, includes practically all the knowledge we have on fascial transplant One hardly ever sees it recognized, for some reason

Dr John Staige Davis (Baltimore, Md) —In these palate and lip cases, I have, during the years, gradually eliminated every bit of foreign material that could be eliminated I use no strips, lead plates, or supporting clamps—in fact, nothing but ordinary waxed silk and horsehair sutures These in the majority of cases are sufficient if the flaps are properly prepared The types of operation used in reconstructing lips and palates are so many that it is impossible to discuss them here It is interesting to those of us who have a considerable number of these cases to deal with, that many of the men doing general surgery are not familiar with the development of this type of work or with the literature on the subject, and that methods that have been in use for a long period of time are often produced by them as new This procedure of Doctor Brenizer's is new to me, but I can see little advantage in introducing fascia strips in either lip or palate I would like to ask Doctor Brenizer whether the scar tissue in the area in which the fascia is implanted is any more dense than it is in the rest of the lip

Dr Addison G Brenizer (closing) —As to the use of fascia, I employed it quite extensively during the war in France, after Dr V P Blair had visited me and turned over the faciomaxillary work to the general surgeons

To support large defects about the mouth and cheeks we used fascia even when exposed to the mouth and nasal cavities, and it remained long enough to exert its holding power or actually persisted and became incorporated

As was stated, in repairing harelips and cleft palates we attempt to securely hold the configuration and the stitching of the parts accomplished at the first operation

By putting the tension on the fascia at a distance from the stitch lines, the line of suture is not pulled upon and with the incorporation of the fascia, strength is added to the flaps Two cases have been cited where bone cells have been conveyed across the hard palate The illustrative cases of both single and double harelip show the maintenance of the configuration of the nose and lips, where fascia or ribbon catgut had been used, and prove its effectiveness in relieving tension on the suture line, where only mucous membrane and muscle sutures were employed and the skin was coaptated with a fine subcuticular wire In answer to Doctor Davis' question as to whether there was not more scarring produced by the use of fascia in the lips The fascia is placed between the mucous membrane and the muscle of the lips The lacerations of the mucous membrane make no difference and the additional scarring in the soft parts, that is, a slight increase in bulkiness, if that is scarring, finally disappears

TRACHEO-ESOPHAGEAL FISTULA

DESCRIPTION OF A NEW OPERATIVE PROCEDURE AND CASE REPORT

HUGH A GAMBLE, M D

GREENVILLE, MISS

THE congenital anomaly of atresia of the esophagus with tracheo-esophageal fistula is of comparatively infrequent occurrence but by no means as rare as usually considered Rosenthal,[3] in 1931, compiled records of 255 cases Gage,[1] in 1936, reported six cases which he had seen during a period of 15 months and in a discussion of his paper Doctor Mixter stated that 23 cases had been observed in the Children's Hospital, Boston, during the preceding ten years Personally, in a rural practice, I have observed two cases during the past seven years, and a search of current literature reveals that the condition is becoming recognized much more frequently than formerly All cases have ultimately succumbed, most of them dying within the first fortnight Levens,[4] however, reports one case which survived for 92 days following operation

The treatment is essentially a surgical problem There is gradually becoming evolved from the cumulative efforts of many operators a procedure which, it is to be hoped, will ultimately result in the saving of some of these children We cannot subscribe to the philosophy of Brennemann when he says "When one considers on the other hand that nearly all of these infants have other anomalies, that practically all of them either have bronchopneumonia or will eventually get it if the upper portion of the esophagus is not drained into the lower portion, that a restitution *ad integrum* of the esophagus does not yet seem possible, that without this life, even if possible, would be intolerable, that the child could not be made to live even if operated upon, for pediatric reasons, that no such infant has ever lived—no matter how treated, and finally that parental sentiment must be weighed heavily in the balance, then if one, after careful counsel with the parents decides to let the patient die as peacefully and painlessly as possible, one would lose no sleep because of that decision"

Direct attack upon the site of the fistula was described by Richter,[5] in 1913 The operation consisted essentially in ligation of the esophagus at its tracheal junction combined with gastrostomy Doctor Mixter has described a method of posterior approach with closure of the fistulous communication and the bringing of the esophagus out through a stab wound, and its immediate utilization as a means of introducing food into the stomach Up until 1930, gastrostomy was the operation practically universally performed and was invariably followed by death within a few days Gage, in 1936, described an operation in which he ligated the esophagus at the cardiac end of the stomach in order to prevent regurgitation of food into the lungs, and at the

same time performed a Saabanajew and Frank gastrostomy Levens described an ingenious operation designed to prevent regurgitation of food, and to date he has probably established a record for longevity of the patient (92 days) His operation consisted of delivering the stomach and lower esophagus and suturing a bridge of tissue beneath it, very much in a manner similar to the

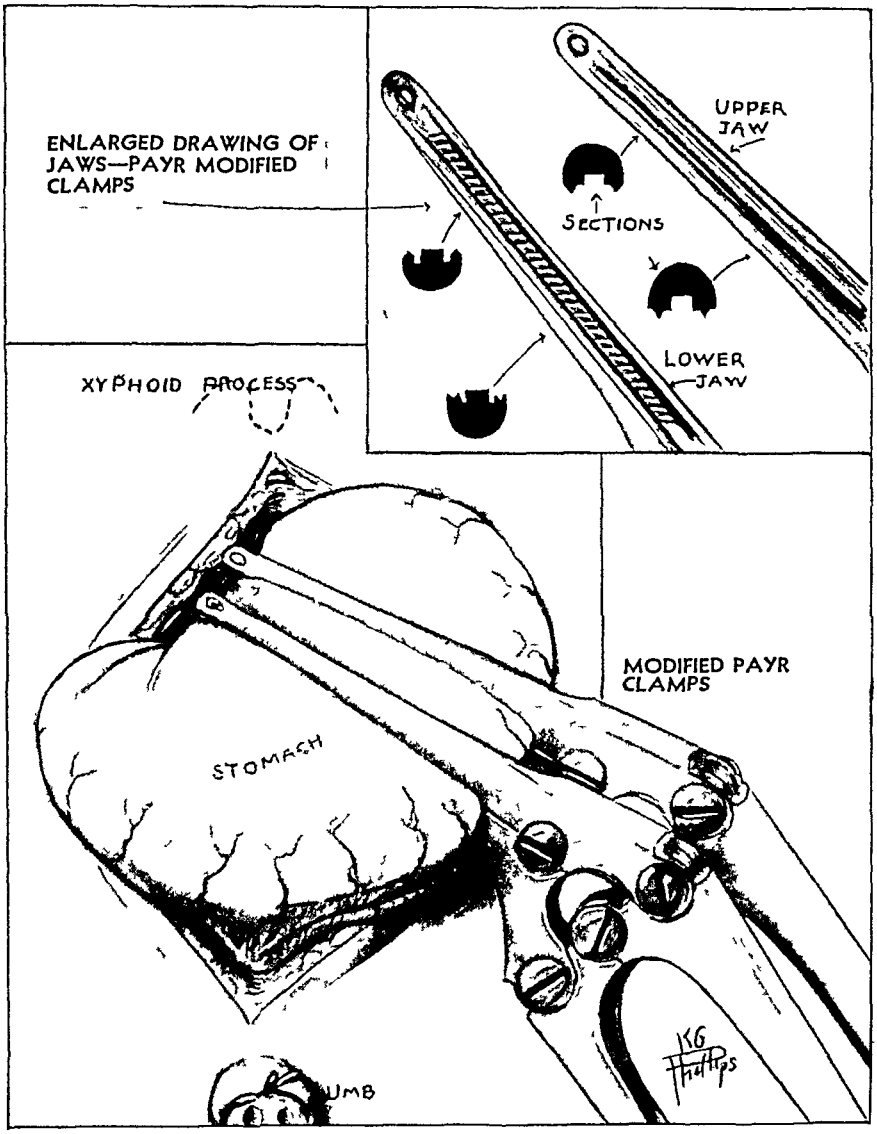


FIG 1 —Division of stomach just below its proximal one fourth Note tongue and groove modification of Payr clamps

first stage of a Mikulicz operation upon the colon, thus angulating the stomach and esophagus and preventing regurgitation, the operation being complete with a gastrostomy and later division of the stomach at the point of angulation

The surgical approach to this problem is either by directly attacking the condition or by indirect methods In the indirect approach at least three stages are necessary in order to relieve this condition The indications in the

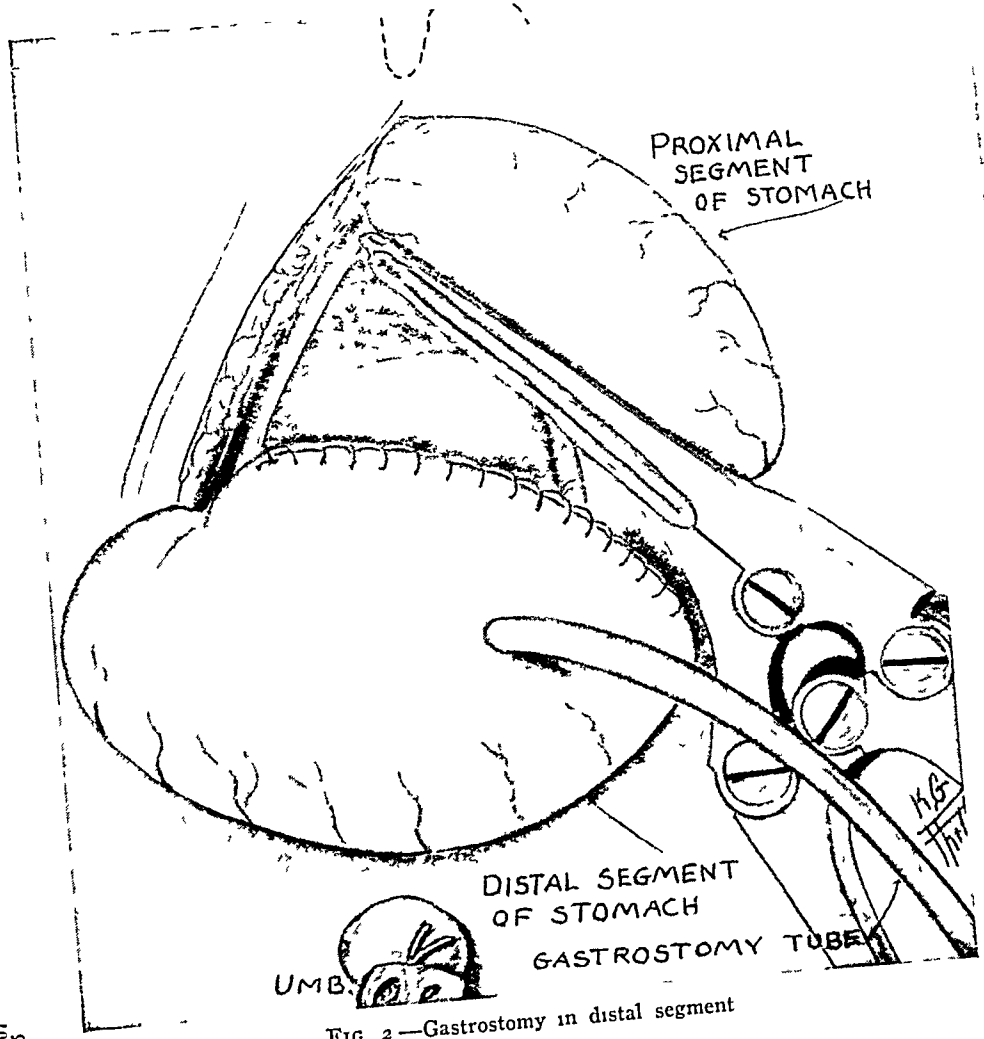


FIG 2.—Gastrostomy in distal segment

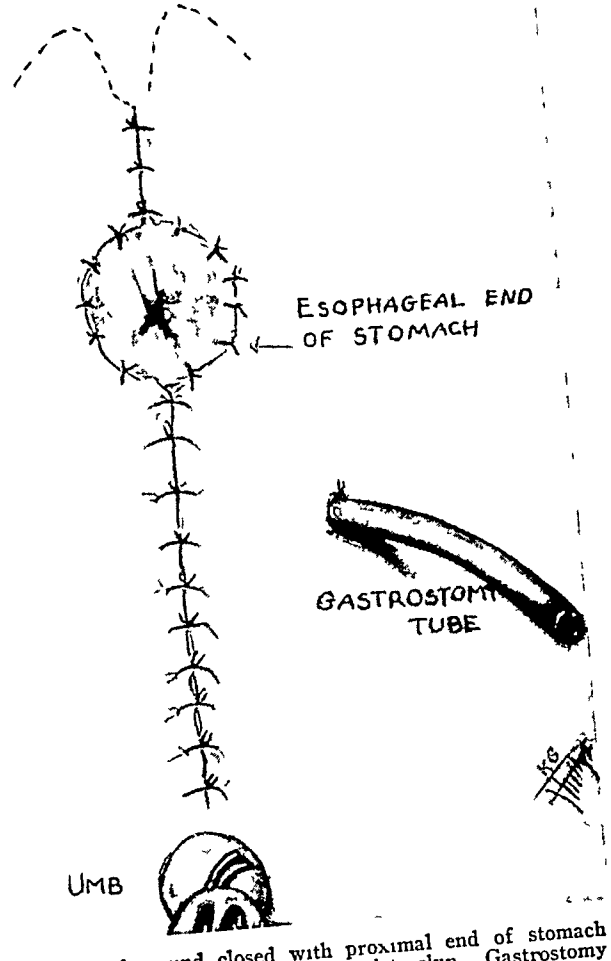


FIG 3.—Abdominal wound closed with proximal end of stomach brought out at upper angle of wound and sutured to skin. Gastrostomy tube brought through stab wound to the left of abdominal incision

Volume 107
Number 5

first stage are (1) To provide a means for nourishing the child, (2) to prevent regurgitation of food, and (3) the prevention of pulmonary complications The second stage is concerned with the reconstruction of the esophagus, and the third stage has to do with the reestablishment of the continuity of the gastro-intestinal tract The operation performed upon our second case was designed to fulfill these requirements

Operative Technic—The stomach was delivered through an incision to the left of the midline and completely transected at its upper fourth between small modified Payr clamps (Fig 1) The proximal end of the distal segment was then completely closed and a gastrostomy of the Stamm or Senn type accomplished at the same time, the gastrostomy tube being brought out through a stab wound to the left of the incision (Fig 2) In this manner regurgitation of food into the lungs was completely eliminated The site for division at the upper fourth of the stomach was selected in order that the esophageal end of the stomach would have a sufficient amount of stomach tissue left to enable one finally—after ultimately reconstructing the esophagus—to reestablish the continuity of the gastro-intestinal tract by anastomosing the two segments of stomach The proximal fourth of the stomach was then brought out at the upper angle of the wound and after closure of the incision the Payr clamps were removed and the stump sutured to the skin (Fig 3) This is an important step toward the prevention of pulmonary complications, as it provides free drainage of the whole bronchial tree It is surprising the large amount of fluid that drains from this esophageal stump Any operation which closes the *esophagus creates a blind pouch which rapidly fills with secretions, which* inevitably regurgitate into the lungs and are an active factor in the causation of the pulmonary complications from which most of these patients succumb The provision for free drainage is an essential feature of the operation An esophagostomy of the proximal esophagus later removes any further menace to the lungs

Case Report—J T S, male, born January 10, 1937, was admitted to the King's Daughters Hospital at 11 A M, January 13 The child was well developed but as soon as he began to nurse developed cyanosis, and regurgitated all food A catheter passed down the esophagus met an obstruction Although the phenomena of strangulation, regurgitation, and the presence of air in the stomach was sufficient to make a positive diagnosis, a roentgenogram was taken which showed the blind esophageal pouch clearly Dehydration was combated by the subcutaneous administration of 5 per cent glucose and at 10 30 P M the operation described was performed under local and light ether anesthesia The baby stood the operation well and it was remarkable how few evidences of shock were present Upon returning to bed a drip of 5 per cent glucose was administered through the gastrostomy The nasopharynx was aspirated at intervals to clear the secretion from the esophageal pouch Progress was without incident until early morning of the fourth day when there developed a slight oozing of blood from the wound It was thought at first that this was due to a prolonged coagulation time due to some blood dyscrasia and he was given 50 cc of whole blood subcutaneously The oozing gradually increased in amount so that on the afternoon of the fifth day the wound was opened and a bleeding point on the lesser curvature of the stomach was secured and ligated Again there was little shock manifested and his progress was satis-

factory until the thirteenth day when his general condition began to retrogress and he died on the fifteenth day

Autopsy showed that death was due to a general peritonitis secondary to the perforation of an ulcer on the anterior wall of the stomach, and that the lungs were not involved in any way The autopsy report by Doctor White follows

Name—J T S Age 15 days Date, January 25

Autopsy Report—The abdomen was distended and there was present a diffuse suppurative peritonitis, resulting from a perforated ulcer in the lower segment of the stomach The esophagus formed a blind pouch running posterior to the trachea for 30 Mm where it ended Opposite this point there was a fistula between the esophagus

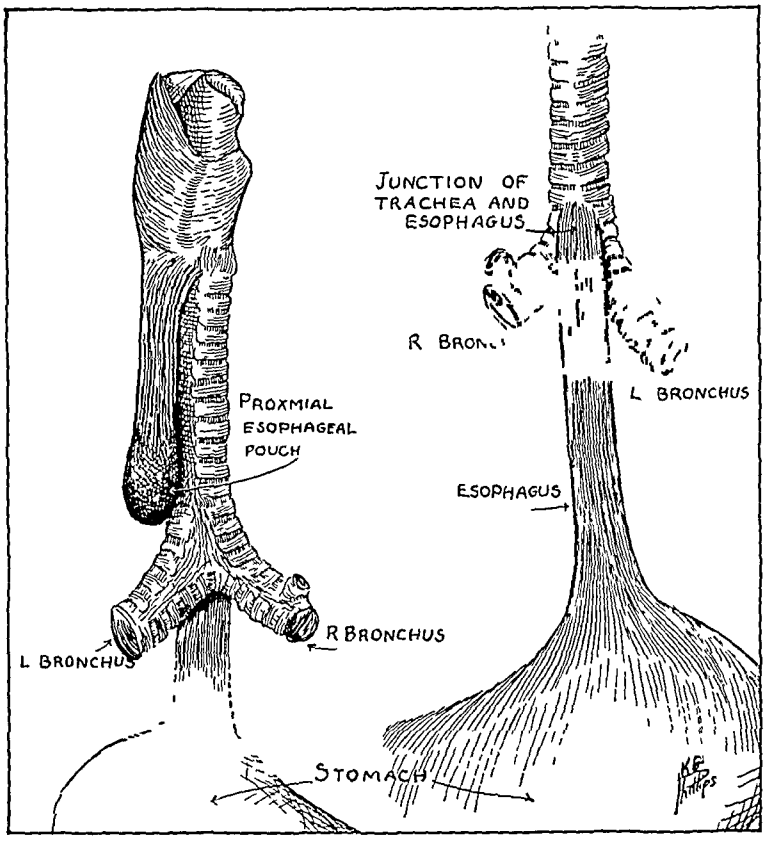


FIG 4—Sketch showing anatomic relations found at autopsy The proximal esophageal pouch ended blindly posterior to the trachea, just above the bifurcation At the same time there was a fistulous communication between the anterior surface of the trachea and the distal segment of the esophagus

and trachea opening on the anterior surface of the latter about 8 Mm above the point where the trachea bifurcates (Fig 4) The lungs were slightly congested but there was no consolidation

Pathologic Diagnosis—General peritonitis following perforated ulcer of the stomach
Anatomic abnormality—Tracheo-esophageal fistula

It was unfortunate that there should have developed a perforation of the stomach, possibly due to interference of the blood supply of the stomach at the second operation for the control of secondary hemorrhage, and that the patient should have died of a general peritonitis However, the case does demonstrate the practicability of transection of the stomach to prevent regurgitation and the benefits accruing from drainage of the esophagus in the

prevention of pulmonary complications The importance of providing for drainage of the distal esophagus and the bronchial tree should again be emphasized, for unless this is done the infant will inevitably succumb to pulmonary complications

CONCLUSIONS

The indirect surgical treatment of congenital tracheo-esophageal fistula should be divided into three stages The indications in the first stage are (1) To provide means for nourishing the infant (2) To prevent pulmonary complications, the most essential features of which are the prevention of regurgitation of food, by transection of the stomach and the drainage of the bronchial tree through the open proximal stump of the stomach, and an esophagostomy of the proximal esophageal pouch The second stage consists in reconstruction of the esophagus and the third stage in the reestablishment of the continuity of the gastro-intestinal tract

An operation has been described which, despite its formidable appearance, is well tolerated by these infants, and which we believe fulfills all of the conditions postulated It or some modification based upon the principles enunciated will solve the problem of the surgical treatment of congenital tracheo-esophageal fistula

REFERENCES

[1] Gage, Mims, and Ochsner, Alton The Surgical Treatment of Congenital Tracheo-esophageal Fistula in the New Born ANNALS OF SURGERY, 103, 725–737, May, 1936

[2] Strong, Robert A, and Cummins, Harold Congenital Atresia of the Oesophagus with Tracheo-oesophageal Fistula Am Jour Dis Child, 47, June, 1934

[3] Rosenthal, Alexander H Congenital Atresia of the Oesophagus with Tracheo-oesophageal Fistula Arch Path, 12, November, 1931

[4] Levens, N Logan Surgical Management of Congenital Atresia of the Oesophagus with Tracheo-oesophageal Fistula Jour Thoracic Surg, October, 1936

[5] Richter, H M A Congenital Atresia of the Oesophagus, an Operation Designed for Its Cure

DISCUSSION —DR VILRAY P BLAIR (St Louis, Mo) —Doctor Gamble has presented a very intriguing surgical problem, and the ingenuity evidenced by him, and his comparatively large experience with this rare occurrence, leave little if anything to be added, especially by one who has never even seen any However, based upon some experience with extensive operations on very young babies, I would corroborate the emphasis he has put upon the importance of early operation

Granting that it be possible to bridge the hiatus between the upper and lower parts of the gullet by an intrathoracic epithelial lined passage, I believe one would be more apt to succeed if this part of the operation were performed within the first 24 hours—better still, within the first four hours after birth, conceivably this might save a gastrostomy From the standpoint of eventual recovery, it would be equally important to, at the same time, give external drainage to the lower end of the blind pharyngeal pouch Either of these would be a formidable procedure, but if done at all, I am inclined to believe that the baby's best chances for ultimate recovery with normal life will be inverse to the age at which both of these are accomplished A four or two

hour old baby probably has had little mouth contamination and less ballooning of the lower end at the blind pharynx The lack of size minimizes the field of most any operation, and except in babies that have been allowed to become jaundiced, bleeding is as a rule very easily controlled In addition to the above there are two other really outstanding advantages in very early operation, both of which dwindle with every passing hour The first is that the baby is not subject to shock, and short of cutting off the breath, great loss of blood or massive crushing of the body or head—a day old baby normally withstands a tremendous amount of trauma, such as being pulled by the neck through a tight parturient canal The second, and possibly greater, is that in the event of death the loss of a day old baby is a minor tragedy compared to that of one that a mother has fondled and suckled I hope for the sake of both baby and parents that Doctor Gamble's next case will be turned over to him before it has had its first bath

SCALENUS NEUROCIRCULATORY COMPRESSION

R GLEN SPURLING, M D , AND F KEITH BRADFORD, M D
LOUISVILLE, KY

FROM THE DEPARTMENT OF SURGERY, UNIVERSITY OF LOUISVILLE SCHOOL OF MEDICINE, LOUISVILLE, KY

ATTENTION was first called to the importance of the scalenus anticus muscle in the cervical rib syndrome by John B Murphy,[1] in 1905 Apparently, he did not fully appreciate the therapeutic value of his observation for he did not suggest cutting the muscle as a step in treatment of this anomaly Adson and Coffey[2] were the first to propose sectioning the scalenus anticus muscle for the relief of symptoms produced by supernumerary ribs Their contribution has stood the test of time and is now the accepted procedure for treatment of this disorder That the symptoms of cervical rib do occur in patients in whom no supernumerary rib can be demonstrated is a matter of common clinical experience Naffziger,[3] however, recognizing the possibility that these symptoms occurring in the absence of a cervical rib might be a definite clinical entity, sectioned the anterior scalenus muscle in a number of his patients, and obtained complete relief of symptoms He considered the symptoms to be due to compression of the artery and plexus between the scalenus muscle and the first rib and called it the "scalenus syndrome" Naffziger told many of his neurosurgical colleagues of his observation, and talked of the disorder before medical meetings, but did not publish his observations upon the subject until January, 1937 Ochsner, Gage, and DeBakey,[4] meanwhile, though giving full credit to Naffziger as the originator of the idea, published the only complete, authoritative, treatise on the subject, in 1934

Our purpose in presenting this report is to review the data assembled from 20 cases of scalenus compression, without cervical rib, which have been treated surgically We are proposing the name "scalenus neurocirculatory compression" instead of "scalenus syndrome" because we feel it more accurately describes the underlying pathologic anatomy

Anatomy of the "Scalenus Angle" (Fig 1) —The scalenus anticus muscle passes downward and slightly lateralward beneath the clavicle and is inserted into the scalene tubercle of the first rib The phrenic nerve courses over this muscle from its lateral border above to its medial border below, leaving the medial edge of the muscle near its insertion to pass into the root of the neck The angle made by the muscle and the portion of the first rib lateral to it is an acute one due to the downward direction of the first rib The subclavian vein emerges from the thorax to pass over the first rib medial to the insertion of the scalenus anticus muscle The subclavian artery, however, passes beneath the muscle to emerge in the vertex of the angle described above before passing over the first rib The brachial plexus lies in the scalenus angle immediately lateral to the subclavian artery The first thoracic and eighth

cervical nerves pass slightly downward, deepest in the angle, and over the first rib to bend rather sharply in coursing to the arm The seventh, sixth, and fifth cervical nerves have a more downward course in inverse order, do not pass as deeply into the scalenus angle, and do not have to change their direction so markedly because of their already downward direction (Fig 1) It may be of importance that subclavian arteries vary in the height at which they take their origin and in the height to which they ascend in the neck before passing into the scalenus angle Variations include the piercing of the scalenus anticus muscle by the subclavian artery, or a separate slip from the muscle may pass posterior to the artery The subclavian artery may be accompanied by the subclavian vein, or the normal position may be reversed

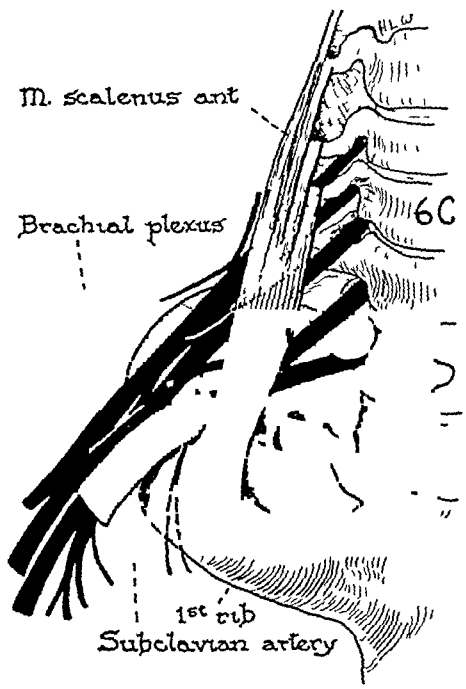


FIG 1—Diagram illustrating the anatomic relationship between the scalenus anticus muscle, first rib, subclavian artery and brachial plexus

The separation of the subclavian artery from its accompanying vein is a situation which finds no analogy elsewhere in the human body It seems reasonable to assume that earlier in the evolutionary development the subclavian artery and vein were together, but that as the scalenus angle developed, the subclavian vein became constricted and collateral veins developed superficial to the muscle, the subclavian vein now represents these collaterals

Incidence—Scalenus neurocirculatory compression is a relatively common clinical entity In a period of two years we have seen 20 cases which were confirmed by their response to surgical treatment As the diagnostic criteria become more generally known, there will be an increasing number of instances recognized These 20 cases were equally divided between the sexes Age was apparently not a factor, the youngest patient being age 17, and the oldest

age 67 In 11 cases the right side alone was involved, in six the left, and in three both sides The occupations were varied and are apparently irrelevant

TABLE I

SUMMARY OF DATA FROM 20 CASES WITH SCALENUS NEUROCIRCULATORY COMPRESSION THAT WERE TREATED SURGICALLY

Case Number	Initials	Race	Sex	Age in Years	Trauma	Duration of Symptoms	Degree of Disability	Subj Weakness	Obj Weakness	Numbness	Pain	Obj Sensory Ch	Immed Result	Late Result
1	O J L	W	F	42	−	3 yrs	Slight	+	+	−	+	+	Good	Well
2	W A R	W	M	31	+	12 yrs	Severe	+	+	+	+	+	Good	Well
3	J E I	W	M	57	−	37 yrs	Severe	−	±	+	+	+	Improved	Well*
4	M W	W	F	31	−	2 yrs	Slight	−	+	+	−	+	Good	Well
5	H R	W	M	18	+	3 mos	Slight	−	+	+	+	+	Good	Well
6	W J	W	M	43	−	9 mos	Moderate	+	+	+	+	+	Good	Well†
7	M B G	W	F	39	±	3 mos	Moderate	+	+	+	+	+	Good	Well
8	J T	W	M	51	+	1 mo	Severe	+	+	+	+	+	Improved	Well
9	F R	W	M	67	−	1 mo	Severe	+	+	+	+	+	Improved	Unknown
10	M D	W	F	27	−	3 yrs	Severe	+	+	+	+	±	Improved	Well†
11	W B	W	M	55	±	3 mos	Moderate	+	+	+	+	+	Improved	Well
12	I B	W	M	17	+	2 wks	Complete	+	+	+	−	+	Improved	Well
13	V L P	W	F	50	−	2 wks	Severe	+	+	−	+	+	Improved	Well
14	H E R	W	M	34	±	3 wks	Complete	−	+	+	+	+	Improved	Well
15	M F	W	F	22	−	2½ yrs	Slight	+	+	−	+	+	Good	Well
16	L G	C	F	38	±	3 mos	Severe	+	+	+	+	+	Good	Unknown
17	C H	W	F	59	+	9 mos	Complete	+	+	+	+	+	Improved	Improved
18	W P T	W	M	35	−	4 mos	Severe	+	+	+	−	+	Good	Well
19	D N	W	F	29	−	3 wks	Moderate	+	+	+	−	+	Good	Well
20	M H	W	F	26	−	2 yrs	Moderate	−	±	−	+	±	Good	Well

* Patient made a complete recovery but died two months later following an appendicectomy
† Minimal residual symptoms with no disability

Symptoms and Signs (Table I) —As would be expected, the symptoms of scalenus neurocirculatory compression are those of cervical rib, and show the same variability The symptoms referable to direct involvement of the brachial plexus are of the most diagnostic importance Usually the medial cord of the plexus is involved alone, or most severely Thus the pain, paresthesiae, and various degrees of sensory impairment are most apt to affect the ulnar distribution (or the dermatomes of CVIII and DI), and, if present in the median and radial distributions also, will be most severe in the ulnar Correspondingly, the small muscles of the hands, the flexors of the fourth and fifth digits, the flexors of the remaining digits, and the flexors of the arm, are usually involved in approximately this order before the extensors become affected

Pain was present in all except four cases In addition to the pain which occurred in the area supplied by the brachial plexus, it was also occasionally present in the deltoid region, supraclavicular fossa, neck, or localized to the region of the seventh cervical spine

It is entirely possible that degrees of compression of the artery which do

not affect the circulation enough to be detected may cause pain through the afferent nerves from the artery The corollary of this may also be true in some instances—that is to say, the circulation of the upper extremity may be affected by involvement of the vasomotor nerves in the brachial plexus without any arterial compression

Numbness or Hypo-esthesia occurred in all 20 patients The ulnar distribution was chiefly affected, although several cases showed impairment of the median distribution and two showed impairment of sensation primarily in the radial distribution

Muscular Weakness of some degree was present in every case, although in two cases it was so slight that it was considered questionable The weakness had been noted by the patient in most, but not all, instances before the motor power was tested Usually the flexors of the fingers were affected along with the intrinsic muscles of the hands In one unilateral case and in one bilateral case, definite atrophy of the intrinsic muscles of the hands was noted

Pulse—This was diminished in one case, and barely perceptible in another In the latter instance the blood pressure could not be obtained on the affected side, and the extremity was cool and pale-purple in color One case with a normal pulse had a cool, edematous hand, but this case was complicated by a definite arthritis By having the patient turn the head toward the involved side and take a deep breath, the radial pulse was obliterated or considerably diminished in all except three cases It was possible to obliterate the pulse by pressure over the scalenus anticus muscle in every instance Often slight pressure was sufficient It must be borne in mind, however, that the pulse can be obliterated in this way in many normal individuals

Scalenus Tenderness was a very constant finding and of great help diagnostically Pressure was made over the scalenus muscle just above the clavicle, and the two sides compared relative to the degree of their sensitivity to pressure In about one-half the cases this maneuver caused, in addition, radiation of tingling or pain down the arm, usually in the ulnar distribution

Pathology—It was noted at operation, that in some cases the scalenus anticus muscle was large and very tense Beneath it, there frequently appeared to be tough, fibrous bands which may, at times, have been a thickened, tendinous posterior covering of the muscle In addition, there were in some instances bands passing beneath the subclavian artery which were attached to the first rib These may have represented variations in the scalenus anticus muscle or bands passing from the transverse process of the seventh cervical vertebra to the first rib, similar, embryologically, to a cervical rib

Specimens of the scalenus anticus muscle were submitted to microscopic examination in seven cases There was an arteriosclerosis of the small arteries in four cases and moderate fibrosis in two These findings, however, were not considered to be of great significance

Etiology—Many explanations have been suggested to explain why, in cases of known cervical rib, many have symptoms only late in life, and many

never have any indication of brachial plexus involvement The shoulder girdle is situated higher in youth, gradually descending as age progresses, thereby forcing the brachial plexus farther into the scalenus angle The shoulder on the dominant (usually right) side drops lower in adults than on the other side, thus predisposing to a brachial plexus involvement on this side We feel that the mechanism which initiates the symptoms in cases of scalenus neurocirculatory compression is much the same as in cases of cervical rib In the group of unilateral cases, 11 involved the right side and six, the left, a right-sided predominance as has been noted in instances of cervical rib However, our cases were divided equally between the sexes, although symptoms from cervical rib predominate in women, due to the fact that their posture allows the shoulder girdle to drop lower than in men

Definite trauma has, apparently, precipitated symptoms in five of the cases, and in two additional cases, both women, the unaccustomed throwing of a soft ball initiated the symptoms The rôle of trauma is so important that two cases are presented to more fully illustrate the relationship

Case 1—I B, white, male, age 17, was perfectly well until January 7, 1937, when, while carrying a 75 pound cake of ice on his back, he felt as though something gave way in his right shoulder This was not accompanied by severe pain, nor did any severe pain occur later Within two hours his right upper extremity became weak, cold, and numb Examination one week later revealed a definite tenderness on pressure over the right scalenus anticus muscle, diminished pulse at right wrist, which was diminished still further by turning the head to the right and taking a deep breath, and was entirely obliterated by pressure over the right scalenus anticus muscle, paresis of the entire right upper extremity, profound ulnar and slight median hypo-esthesia Two weeks after he was first seen the symptoms had become still further advanced, and a section of the right scalenus anticus muscle was performed under local procain anesthesia Immediately after the muscle and the bands beneath it were divided, the patient felt an improvement in the numbness of his hand and arm The motor weakness rapidly disappeared during the following week, and the patient has remained free of symptoms

Case 2—W A R, white, male, age 31, sustained a rather severe injury to his neck and left shoulder region while playing football, in 1924, since which time he has had vague pains in this area In 1929, there was transient numbness in the ulnar nerve distribution, and from time to time some weakness of the left arm On May 8, 1936, the patient wrenched his neck by being thrown against the roof of his automobile Severe aching pain in the left shoulder persisted for 36 hours and was followed by progressive weakness in the left hand and numbness in the ulnar side of the left hand and arm

Examination elicited marked tenderness over the left scalenus anticus muscle Pressure upon it or depression of the shoulder caused tingling paresthesiae down the ulnar distribution The circumference of the left forearm was 2 cm less than on the right side There was marked weakness of the left grip, and to a less extent of the whole left arm Roentgenologic examination was negative for cervical rib

Two weeks later a further progression of symptoms was noted, and the scalenus anticus muscle was sectioned There was a fibrous band beneath it, constricting the subclavian artery There was immediate improvement in the motor power of the left hand, the numbness disappeared, the patient has remained completely free of symptoms

Treatment—We have seen a number of cases of scalenus neurocirculatory compression with symptoms so mild that surgery was not suggested Relief has been obtained by using a figure-of-8 bandage about the shoulders or by

elevating the elbow by means of a sling Nocturnal symptoms have frequently been prevented by having the patient sleep with the affected arm above the head Relief by these measures is of diagnostic aid Probably many of these mild cases will have to be operated upon eventually, however We have operated upon only those cases in which the symptoms caused disablement to a moderate or severe degree

The bilateral cases should be operated upon on one side at a time, because of the inevitable phrenic paralysis or paresis following anterior scalenotomy In instances where it was not even necessary to retract the phrenic nerve, paralysis has occurred just the same It is possible that the springing apart of the stretched muscle after cutting makes sufficient traction upon the phrenic nerve to impair its function The phrenic paralysis has been found to disappear in about six weeks

Operative Technic—An incision 4 cm long is made 2 cm above the clavicle, parallel with it, overlapping the lateral edge of the sternocleidomastoid muscle It is usually possible to avoid the external jugular vein The platysma is divided and the clavicular portion of the sternocleidomastoid muscle retracted medially Ordinarily, the posterior belly of the omohyoid muscle can be retracted, if not, it is cut The deep fascia is divided, care being taken to identify the transverse cervical vessels or other large vessels which may be present, and the scalenus anticus muscle becomes exposed At the level of this incision the phrenic nerve, as a rule, courses along the medial edge of the muscle A small portion of the muscle beneath the phrenic nerve is separated with it in order to protect it and is then either retracted or allowed to retract medially Usually the internal jugular vein is exposed medially, appearing beneath the sternocleidomastoid muscle

The scalenus anticus muscle is separated from the deeper structures by placing a retractor beneath it It is sectioned piecemeal Care is taken to sever completely the tendinous posterior covering of the muscle and any fibrous bands passing beneath it Palpation within the wound frequently reveals the presence of bands which cannot be seen In this way part of the brachial plexus is exposed and usually the subclavian artery, although at times the latter can be palpated only behind the clavicle After careful hemostasis, a small rubber tissue drain is left in the dead space, and the deep and superficial fasciae, and skin are closed with separate rows of interrupted silk sutures The drain is removed after 12 to 24 hours

Prognosis and Results—The immediate result of operation was good in all 20 cases Many recovered normal sensation and relief from pain while still on the operating table, while others required several days or weeks Improvement in motor weakness was equally prompt in some instances, and slower in others One of the bilateral cases, in which an excellent result was obtained, died three months postoperative, following an appendicectomy Two cases could not be traced Of the remaining 17 cases, all are without symptoms with three exceptions One has annoying paresthesiae in the ulnar nerve distribution, but his pain, weakness, and hypo-esthesia have disappeared In

the second case there is occasionally a tired feeling on the operated side, with some guarding of this arm, but the patient works regularly and is free from pain The third case was complicated by an arthritis of the hand and shoulder The ulnar hypo-esthesia and weakness of the hand, however, have disappeared The pain in the shoulder has improved somewhat, but is still disabling Since this case is only three weeks postoperative, it is hoped that the arthritis may have been secondary to circulatory changes due to scalenus compression and may yet clear up

Discussion—That trauma about the neck or shoulder does precipitate compression within the "scalenus angle" naturally leads to many interesting speculations Probably some patients who have been considered to have had torn brachial plexuses, or avulsed roots of the plexus from direct trauma to the arm or shoulder may have nothing more than scalenus compression We have seen two such cases not included in this report—one of them several weeks after the injury and one almost a year after—who had the usual signs of scalenus compression Both, however, had complete peripheral nerve lesions Section of the scalenus anticus muscle improved the circulation but did not improve the paralysis In both cases the plexus was demonstrated not to have been torn Also, some of the brachial birth palsies, particularly those which do not have an accompanying Horner's syndrome, may be due to this lesion So far, we have had no opportunity to observe newborn infants of this type

"Neuritis" is one of the more frequent of human ailments If we eliminate from consideration those cases of frank polyneuritis of infectious, chemical, deficiency, or toxic origin, we find in most instances pain and disability limited to one arm or one leg When pathology in the joints is ruled out, such pain in the arm and shoulder is commonly termed "brachial neuritis" and in the leg "sciatica" It is unnecessary for us to review the unsatisfactory methods of treatment which have been available for these chronic cases of "neuritis" in the past Fortunately, in recent years a better understanding of the underlying causes of a painful arm or leg has come about, especially in the latter case Nowadays the patient with sciatic pain is properly studied from the point of view of mechanical compression of the nerve or its component roots In most of the chronic cases one is able to demonstrate a lesion within or of the spine, or in the course of the sciatic nerve Once the cause is found, treatment can be directed to the cause rather than to the relief of the symptom

In cases with arm pain, our knowledge is in a more nebulous state After arthritis of the shoulder joint, diseases of the bursa or tendons about the shoulder, and cervical ribs have been eliminated, we have formerly often been forced to conclude that the patient suffered with "neuritis" of unknown etiology A more general appreciation of the signs and symptoms of compression within the "scalenus angle" will, doubtless, clarify many of the cases of unexplained brachial neuritis From our experience we feel that it is probably one of the most common causes of the painful arm and shoulder

REFERENCES

[1] Murphy, John B A Case of Cervical Rib with Symptoms Resembling Subclavian Aneurysm ANNALS OF SURGERY, 41, 399, March, 1905
[2] Adson, A W, and Coffey, J R Cervical Rib ANNALS OF SURGERY, 85, 839, 1927
[3] Naffziger, Howard Scalenous Syndrome Surg, Gynec, and Obstet, January, 1937
[4] Ochsner, A, Gage, M, and DeBakey, M Scalenus Anticus (Naffziger) Syndrome Am Jour Surg, 28, 669–695, June, 1935

DISCUSSION —DR R ARNOLD GRISWOLD (Louisville, Ky) —Doctor Spurling has brought out the traumatic origin of many of these cases This is becoming increasingly important from the medicolegal standpoint I should like to put two such cases on record The first was a roofing worker who fell from a ladder, falling ten feet and then catching the ladder, bearing his full weight on that arm He immediately experienced pain which subsided, but was followed in 24 hours by severe pain and paresthesia on that side He was relieved by operation

The second case was a woman who was riding in the back seat of an automobile, saw that a collision was impending, and reached over the seat to catch her child She was in this position when the accident occurred, and had immediate pain over the clavicle Within a few days there was pain, paresthesia and a typical scalenus syndrome She was relieved by operation Interestingly enough, both these cases were accepted by insurance companies as being traumatic in origin

A third patient who was operated upon three years ago for pericarditis has as a result a soft spot over the heart Unconsciously, in order to protect this soft spot this patient drops his shoulders forward Two years after operation he began to develop a scalenus syndrome on both sides, the etiologic factor here being, apparently, the result of a defective posture

DR KENNETH AYNESWORTH (Waco, Texas) —I am very much interested in this paper because I have a daughter who has this in a mild form on both sides, and my next-door neighbor was operated upon for bilateral scalenus neurocirculatory compression I have asked this question of every patient I have seen "How do you sleep?" Without exception, all of them have said, "I have to sleep with my hands over my head" I would like to emphasize that fact One patient, a farmer, who has developed this trouble, states that he has to sleep with the right arm over his head to obtain comfort Another patient, a woman, age 64, fell downstairs, striking her right shoulder, and suffered pain in the right side of the neck and shoulder for some weeks On a long automobile trip she had to give up driving because of the pain in the right side of the neck and down the right arm, it was felt along the distribution of the ulnar nerve and was associated with some edema and paresthesia of the entire arm Within a month, she was absolutely unable to use the right arm An internist diagnosed arthritis and neuralgia and put the arm in a plaster splint, which gave some temporary relief but the pain soon became worse In consultation I made a diagnosis of scalenus syndrome The operation was performed under local anesthesia in the morning and when I came back to see her in the afternoon she reached out and shook hands with me, a thing which she had not been able to do for four months There has been no return of her discomfort

CARCINOMA OF THE BREAST IN THE NEGRO

ISIDORE COHN, M D

NEW ORLEANS, LA

THIS study was undertaken to determine if possible what the present status of carcinoma of the breast in the Negro is, as treated at Charity Hospital, New Orleans We have made an effort to determine the relative frequency in the white and the Negro races, the stage of development of cancer of the breast at the time of admission, and the methods of treatment employed as well as the results which have been obtained

Several obstacles were encountered in our efforts to obtain data It has been particularly difficult to obtain follow-up records as many of the patients lived in distant parts of the state, many have moved from their former address without leaving a tangible way of following them, and a third but definite factor, different names are often affected by the same patient

In our efforts to obtain follow-up records, the State Board of Health has been particularly helpful A member of their staff undertook to check a list of patients discharged from the hospital against reported deaths from the localities given as the home address by those patients In this way we obtained most of the data relative to the "known dead" since leaving the hospital The Superintendent of the City Board of Health permitted a member of our staff to study the records in his department In this manner we obtained further data Much information which would have been of great value could not be obtained because the records of histories and physical examinations at the hospital are often brief, much important data having been omitted It has not been possible to compile satisfactory data with reference to the exact location of the tumor (quadrants of the breast), its size, the occurrence of skin involvement, and much other information which would have been of value

This report is not intended to be comparable, from a statistical standpoint, with other reports for several reasons (1) Cases are included which have been operated upon less than one year (2) The complete data as to the total number of dead have not been obtainable

It will not be our purpose to laud any particular operative procedure, nor a combination of methods of treatment We will, however, present, in as concrete a form a possible, some data with reference to

(1) The incidence of carcinoma of the breast in the Negro
(2) The average age
(3) The duration of symptoms and signs before applying for treatment
(4) Stage of development of the disease at the time of admission
(5) The incidence of metastasis on admission
(6) A discussion of the preoperative study of the patient

(7) The surgical treatment applied
(8) Irradiation as applied
(9) The known mortality

Incidence—Any report on the incidence of carcinoma of the breast in the Negro would be incomplete without reference to the classic work of Dr Rudolph Matas,[1] 1896, of Frederick Hoffman,[2, 3, 4] and more recently, the splendid work of Maes and McFetridge[6]

In view of the incidence of carcinoma of the breast in the Negro population in New Orleans and the rarity in the native African population, it is of interest to quote facts presented by Doctor Matas in his address on "The Surgical Peculiarities of the Negro"

Doctor Matas points to the following facts "All of the Negroes on the American Continent are directly descended from the black slaves imported from Africa during the slave trade

"In 1619, a Dutch ship landed a cargo of slaves in the colony of Virginia From 1619 to 1776, more than 300,000 African bondsmen were imported into the thirteen British colonies

"In 1865, the slave population had increased to four millions

"In 1890, the black and mixed or mulatto population had increased to 7,470,000, or 11 93 per cent of the total population of the United States"[1]

The Negro population of America is no longer a pure race In considering pathologic states, again we refer to Matas' work He says "Mulattoes, and especially those of Anglo-Saxon crossing, have not the strength and endurance of either of the pure races"[1]

Frederick Hoffman states[2] *"Cancer is practically never met with among strictly primitive types not in close contact with civilization*

"Cancer of the breast is relatively common among our Negro women, whose habits and mode of living, for all practical purposes, are almost identical with those of women of the white population"

Hoffman, in his study of cancer among Indians, made the following observations

"Cancer among the primitive Indian population is unquestionably of exceptionally rare occurrence"[3] "Proportion of Distribution of Cancer Deaths by Organs and Parts, U S Indian Population and U S Registration Area, 1921–1925[5] U S, 1924, breast, 9 1 per cent Indians, 1921–1925, 4 7 per cent"

Deaver and McFarland[5] state "Cancer of the breast is undoubtedly a rare disease among the native African Negroes, it is, as we shall show later, quite common among the American Negroes Cancer is likewise rare among the Negro population of the Panama canal zone Doctor Noland[5] of the Colon Hospital, Cristobal, Canal Zone, states that only 35 cases of cancer were found among 54,249 patients treated at the hospital during the past five years"

Maes and McFetridge,[6] in their study of hospital admissions from 1924–

1933, showed that the incidence of breast malignancies was greater in the colored than in the white

In 1934, Smith and Elmes[7] reported relative to malignant diseases in natives of Nigeria "It has been the general impression within recent times that the dark skinned races are not so prone to contract malignant disease as those of lighter hue"[7] They recorded 29 cases of cancer of the breast among 500 malignancies observed Renner has remarked the increasing frequency of carcinoma of the breast in the mixed races of Sierra Leone compared to the native pure race Vint[8] states "The following observation may be useful as a contribution to our knowledge of cancer in races living in a primitive environment In 2,378 tissues from the natives of Keyna, examined for all conditions, I have found 546, or 23 per cent, with malignant change"

TABLE I[8]

ANALYSIS OF TYPES OF 546 TUMORS EXAMINED BY VINT, OCCURRING AMONG 2,378 TISSUES TAKEN FROM NATIVES OF KEYNA

Type	No	Per Cent	Smith and Elmes[7] Nigeria Percentage
Carcinomata*	277	50 7	48 6%
Sarcomata†	178	34 4	36 0%
Melanomata	59	10 8	8 0%
Endotheliomata	15	2 7	3 4%
Teratoblastomata	14	2 4	0 4%
Chorion epitheliomata	2	0 3	0 2%
Hypernephroma	1	0 1	

* Including ten mixed tumors of the parotid

† Including myeloid sarcoma

TABLE III[8]

SITE AND PERCENTAGE OF INCIDENCE OF THE 277 CARCINOMATA (VINT[8])

Site	No	Per Cent	Site	No	Per Cent
Limbs (skin)	64	23 1	Pancreas	6	2 1
Liver, primary	38	13 7	Trunk (skin)	6	2 1
Nodes (lymph)	29	10 4	Stomach	5	1 8
Breast†	25	9 0	Liver,* secondary	4	1 4
Lip, mouth and palate	17	6 1	Abdominal cavity*	4	1 4
Face and head	15	5 4	Larynx, kidney, esophagus, rectum, thyroid, bladder, (each)	2	0 7
Genitalia Male	15	5 4			
Female	13	4 6			
Parotid gland	10	3 6	Unspecified	14	5 0

* Site of primary growth not stated

† Malignant disease of the breast is not uncommon in the East African native, 25 carcinomatous and four sarcomatous growths being seen, a percentage of 5 3 of the malignant tumors[8]

In the group under consideration at the Charity Hospital, there was a total of 481 cases, white and colored Of this number, there were 256 colored and 225 white (Table I), a slight preponderance of the incidence in the Negro race These figures probably are more nearly correct than figures that might be assembled from centers of population where the relative percentage of white and colored is disproportionate

From statistics we have gathered, you will note that the per thousand admissions of breast carcinomata have been fairly constant during the five-year period 1932–1936, inclusive—1 7 to 1 8 per thousand admissions (Table I)

From the above figures there is no reason to assume that there is an actual increase in malignancy of the breast in the colored race at this time

When these facts are noted and compared with adequate statistics with reference to the native Africans and races other than Caucasians, they definitely indicate the importance of amalgamation and environmental conditions as indicated by Dr Rudolph Matas 40 years ago

The second fact that we sought to elicit was the average age for the two races It was found that the average age for the Negro was 4 7 years younger than the white (Table II) It is further evident that the greatest number in the colored group is found between ages 40 and 50 while in the white race it is between ages 50 and 60 (Table II)

The Pregnancy Factor —It was found that there was a much higher incidence of carcinoma of the breast in nulliparous Negroes than in white nulliparous women In this series there were 36 Negroes and 13 whites who had not been pregnant The pregnancy factor from this study does not seem per se to be a predisposing cause of cancer of the breast (Table III)

Duration of Symptoms Prior to Admission —In this investigation a study of the duration of symptoms establishes for this series at least certain facts

(1) The histories were inadequate on this point in nearly 10 per cent of the series

(2) Where the duration of symptoms is mentioned we find that the cases could be divided into three groups From one to nine months, nine to 12 months, and those having symptoms more than one year It has been exceedingly interesting to note the few cases which have been admitted in the nine to 12-month period (Table VI)

The average duration of symptoms for all admissions is 1 6 years The average for those having symptoms less than one and one-half years was 7 2 months In the colored race 21 3 per cent of the cases and 21 2 per cent of all cases in the white race had symptoms for more than one year and a half on admission (Table VI) What significance may be attributed to this is problematical It may be as suggested by one of us (R P), that these cases with long duration of symptoms represent cancer lesions engrafted upon either benign conditions or precancerous lesions There was a very small group of patients in the colored and in the white who were admitted during the nine to 12-month period In looking over the statistics of the known

dead and comparing the number of known dead with the duration of symptoms, the highest percentage of known dead is found to have occurred in those patients admitted in the nine to 12-month period

Lymph Node Involvement—The fact that 60.6 per cent of the colored patients and 53.1 per cent of the white patients had axillary metastases indicates the late appearance of this group for examination in a public institution (Table VII) This fact makes it unfair to compare end-results with those obtainable in private practice It is, however, a challenge to the profession to further their efforts to stimulate public interest in earlier examination and in greater care of the cases which come under observation

Mortality in Groups With and Without Lymph Node Involvement—Our statistics indicate that approximately 118 Negroes had radical operations Of these 118, 63 with lymph node involvement were operated upon, 29 of whom are known to be dead, a percentage of 46 Of those without node involvement, 25 per cent are known to be dead, which would be an average of 36 per cent for both groups where radical operations were performed The status of 57 of the radical operations is not known definitely There are at least 12 cases which we have not been able to trace which are probably dead This would raise the mortality up to date to about 65 per cent from one to four years after operation Even this we believe to be too low an estimate, when we consider the late period of admission and 60 per cent of lymph node metastases at the time of operation

A study of the known dead in the various age groups indicates that cancer of the breast in our series for the 30 to 40 decade had a shorter life expectancy than in any other decade Of the total of 224 colored patients with carcinoma of the breast, the known dead were 66, or 29 per cent At least 30 other cases which we have been unable to trace are probably dead This would increase the mortality for the total series of colored patients, irrespective of whether a radical or palliative operation or no operation was indicated, to 43 per cent from one to four years after admission to the hospital It is felt that even that figure is too low We will continue to try to trace these patients and possibly at a later date more accurate data will be available (Table XV)

Surgical Treatment—We find that of the total 224 colored patients in this series, whose records are considered adequate, 118 were considered eligible for radical operation and postoperative irradiation, 46 for palliative operation and irradiation, radiation alone, 29, and 27 were considered absolutely inoperable If we consider the 46 upon whom only a palliative operation could be performed, and 29 upon whom only irradiation could be used as a palliative measure, and the 27 considered absolutely inoperable (Table XII), as probably dead, and we add these to the known dead in the series, the probable total number will be raised to 168, or 75 per cent of the total number of colored patients who have applied for admissions to the Charity Hospital with carcinoma of the breast during the last five years

The high incidence of patients upon whom either a palliative operation or

no surgery could be employed indicates the late stage on admission and the extensive local or metastatic involvement present at the time of admission Irradiation before operation has been administered very rarely in this group This can be explained in three ways (1) The lateness of admission, (2) extensive involvement, and (3) the possibility of delay causing progress of the disease, greater than could be controlled by the irradiation therapy Some of us believe that a period of two months' delay would further jeopardize the chances of success that any radical procedure might have

When one comes to consider the treatment of such a group, he is of course confronted with possible criticism for not having used preoperative irradiation before surgery was instituted We consider that the time element is important Two months' delay would be dangerous unless it could be shown that irradiation positively destroyed the cancer cells in the metastatic nodes as well as in the primary tumor, and this has not been established to our satisfaction, even the extensive experience of Mr Geoffrey Keynes[13] does not prove that point

Cohn[9] has reviewed 192 cases of carcinoma of the breast treated during a five-year period, 1931–1935 inclusive, and concludes that "There is apparently no evidence that the addition of preoperative irradiation prolongs the duration of life in those persons who are to die of the disease" He adds 'That there is apparently no danger in delaying the complete operation for one course of preoperative irradiation" He further states "The factors which seem to influence the prognosis are grade of malignancy of the tumor, the presence or absence of lymphatic involvement and the extent of the involvement"

Comment—In our series it will be noted that 60 per cent of the colored patients had evidence of axillary involvement on admission and the extent of breast involvement was great These two factors would at once indicate a short duration of life postoperatively

Adair and Stewart,[10] in 1935, reported on the value of preoperative irradiation in breast cancer "It is shown that the radium element pack as applied in a group of 39 cases destroyed the breast cancer in 28 per cent of the cases In a similar group of 42 operable cases treated by the 200 K V roentgen ray machine, the breast cancer was destroyed in 16 5 per cent of the cases *It is also shown that external irradiation as applied in this series did not effectively combat axillary disease,* and this fact points to the necessity of giving additional interstitial irradiation"

McKittrick[11] states that (1) "Interstitial radiation is an efficient and practical method of radiating a breast cancer

(2) "The finding of viable cancer cells in surgical and autopsy specimens, the pain in, and fixation of the pectoral ridge and the late deformity of the breast after radiation, represent hazards which in our minds render this form of treatment less desirable than surgery in cases of primary operable cancer of the breast

(3) "In an inoperable cancer of the breast where the tumor occupies no more than one quadrant of the breast it may be the treatment of choice

(4) "It has no advantage over roentgen ray in the management of large massive lesions or in lesions which have shown little response to adequate roentgenotherapy.

(5) "It cannot be depended upon to protect the axilla against metastatic invasion"

Hutchinson,[12] from a study of the literature, concludes that "X-ray therapy, when scientifically employed, has been shown to produce results which surpass those of any other procedure" His article is interesting because of the comparative, excellent statistics which he has compiled Surgery plus roentgenotherapy in his cases resulted in a total of five-year cures of 40 9 per cent, while roentgenotherapy *alone* showed 42 3 per cent free from recurrence at the end of five years

Geoffrey Keynes[13] states "I am prepared to maintain that if axillary lymph nodes are extensively involved, dissection of the axilla may be harmful, and if they do not appear to be involved at all, it is unnecessary This is coupled with the assumption that radical irradiation will be carried out in every case"

Keynes found evidence of active cancer cells in 50 per cent after irradiation In operating he never included removal of the pectoral muscles or dissection of the axilla, and states[13] "Close observation of the patients over many years has shown that the results on the axillary nodes have been uniformly good They have been made to disappear almost with certainty, and they have not recurred If the axilla did not contain palpable nodes none have developed afterwards" Comparison of this statement with the work of Adair and McKittrick shows failure of agreement In talking personally with Mr Keynes and also discussing the question with Mr Patterson Ross of the same institution, it was my impression that only about 50 per cent of the irradiated breasts were free from active cancer cells after six months

If, then, the most enthusiastic advocates of irradiation, either preoperatively or as a sole means of treatment, show no better results than those given by Adair and Mr Keynes, it would seem logical, in late cases such as has been our opportunity to observe, not to resort to irradiation preoperatively

Preoperative Roentgenotherapy—It is our firm belief that no radical operation should be performed for carcinoma of the breast without having a roentgenologic study made to determine as accurately as possible whether metastases are present or not In this series, 74 per cent of the colored patients who were submitted to a radical procedure had roentgenologic studies made before operation Sixty-nine per cent of those upon whom palliative operations were performed had similar studies made (Table IX) It is rather interesting to note that the percentage of these studies in the colored patients was about 15 per cent greater than in the white The roentgenologic studies were limited to the thoracic cage, the skull and long bones were not included in the majority of cases This omission might account for not finding more

skeletal metastases preoperatively We believe that greater attention should be paid to the information which can and should be obtained from a thorough preoperative roentgenologic investigation of the skeleton

Biopsies—Biopsies were performed in only a small percentage of cases, less than 10 per cent In 26 of these the biopsies were followed by radical operation, 16 immediately, ten at a later date It is our belief that if biopsies are performed the radical operation should be undertaken at the same sitting

Too much dependence cannot be placed on the biopsy if it is negative, as tumor cells may be present in one section of the tumor and not in another The method of obtaining the biopsy is of course important Adair and Stewart state that the aspiration method of biopsy can be fully relied upon The frozen section is not always a satisfactory criterion The care with which histologic examinations are made increases the value of the immediate biopsy report

SUMMARY

(1) During the period 1932–1936 inclusive, 481 cases of carcinoma of the breast were admitted to Charity Hospital Of these, 256 were Negroes, 225 were white

(2) The per thousand cancer of the breast admissions (colored) to the total admissions has remained constant—1 7 per cent for the period under study

(3) More nulliparous Negro women have presented themselves with cancer of the breast than white

(4) The age of the Negro patient averages about 4 7 years younger than the white The greatest number of cases are in the decade between ages 40 and 50 in the colored and between ages 50 and 60 in the white

(5) Sixty per cent of the cases had metastases in the axillary lymph nodes on admission

(6) Of 224 cases in which the records were adequate for use in this study, only 118 were considered suitable for radical operation No operation was considered indicated in 27 cases These facts further indicate the late period in which this group present themselves

(7) The percentage of known dead following radical operation is given as 46 If we add those cases which we have been unable to trace it is believed that the percentage dead from one to five years will be well above 65 per cent

(8) Of a total of 224 cases of carcinoma of the breast cases which are considered in this series, probably 75 per cent are dead in from one to four years after their admission to Charity Hospital

(9) Only 74 per cent of the colored patients had any form of roentgenologic investigation preoperatively Therefore, the percentage of skeletal metastases cannot be accurately estimated from this series

(10) Irradiation either with roentgen ray or radium was not the method of choice in any of the operable cases

(11) The facts presented above are a challenge to the profession to continue their efforts to educate the public End-results can be improved by other methods than studies of etiology

(12) Future study will be presented on the type of cancer with reference to the mortality

STATISTICAL RÉSUMÉ OF CASES OF CARCINOMA OF THE BREAST OCCURRING IN THE NEGRO

(Charity Hospital, New Orleans, La , 1931–1936, inclusive)

PREPARED BY

DRS ISIDORE COHN, RAWLEY PENICK, AND SAMUEL KARLIN

TABLE I

ADMISSIONS, YEARS 1932–1936 INCLUSIVE

	White	Colored	Totals
Primary admissions	175	224	399
Secondary admissions	50	32	82

IN PRIMARY ADMISSIONS

Year	Total Admissions Carcinoma of Breast		Total Hospital Admissions		No Carcinoma Breast per Thousand	
	White	Colored	White	Colored	White	Colored
1932	23	35	28,759	19,318	8	1 7
1933	41	39	32,747	22,690	1 2	1 7
1934	28	38	37,335	26,726	0 7	1 4
1935	43	41	40,125	29,097	1 0	1 4
1936	29	53	37,497	28,312	0 7	1 8

Those cases diagnosed as carcinoma of the breast but which have had no previous surgery are designated as primary admissions The so-called "secondary admissions" are those cases of carcinoma of the breast admitted to the hospital only after having had surgical treatment elsewhere They form, therefore, a group unsuitable for the statistical data presented For this reason they were excluded

Table I shows, in part, the number of patients admitted to the hospital in 1932–1936, inclusive, contrasted with the cases of carcinoma of the breast for the same period Breast malignancies per thousand admissions have remained

fairly constant for both races Moreover, the percentage of incidence among the Negroes exceeded that of the whites

TABLE II

AGE DISTRIBUTION

Decade	White	Colored
20–30	2	10
30–40	28	37
40–50	35	81
50–60	59	53
60 and above	51	43
Average age	53 3	48 6

TABLE III

PREVIOUS PREGNANCIES

	White	Colored
Incomplete records	75	75
No pregnancies	13	36
1	8	29
2	18	16
3	12	18
4	15	6
5	6	11
6	7	4
7	9	2
8	2	4
9	4	3
10	0	8
11	1	4
12	2	2
13	2	1
14	1	3
16	0	2
18	0	1
Average No of pregnancies	4 0	2 5

Table II gives the age distribution of patients on their first admission to the hospital This does not include the so-called "secondary" admissions The number of patients in the third decade of life is much larger in the Negro group, being 4 4 per cent of the total number, while the whites in the same decade are only 1 1 per cent Furthermore, there is another indication that cancer of the breast is occurring in the Negro at an earlier age than in the white, for, whereas the largest group among the Negro falls in the fifth decade, the largest group among the whites is to be found in the sixth decade

The average age also indicates this It will be seen that the average age of the Negro is 4 7 years less than the white This difference is all the more striking when it is remembered that the Negro generally seeks medical aid late

It is interesting to find a much larger number of patients without previous pregnancies among the Negroes than among the whites (Negro, 36 = 1 6%, White, 13 = 0 7%) It is evident that the average number of pregnancies is almost twice as great for the whites

TABLE IV

PREGNANCIES IN PATIENTS BELOW 30 YEARS OF AGE

	Total No	Pregnancies Not Noted	Average No Pregnancies
White	2	1	5 0
Colored	10	3	1 4

If Table II is correlated with Table I which considers the incidence of carcinoma in cases admitted to the Charity Hospital, it would seem that the Negro has as much or more cancer of the breast, and yet the above figures indicate the Negro averages fewer pregnancies Therefore, it seems justifiable to conclude from this series that pregnancy per se is not an essential factor to be considered as predisposing to cancer

An effort was made to study the number of pregnancies in patients less than 30 years of age but in the majority of cases, the histories did not record this data

TABLE V

PREGNANCIES IN PATIENTS WITH SYMPTOMS OF TWO MONTHS OR LESS

	Patients	Pregnancies	Average
White	18	73	4 0
Colored	22	80	3 6

Thirty-seven histories failed to record the duration of the patients' symptoms This comparatively large number of records on which this important fact was not noted indicates a weakness prevalent in many hospitals Several conclusions, however, can be drawn from this table It is evident that, in as far as duration of symptoms is concerned, the cases fall into two rough groups, *i e*, those with symptoms less than nine months and those having symptoms more than one year Very few cases come into the hospital in the nine to 12-month period after observing the first symptom It will be seen that the group having symptoms less than nine months about equals the late group in both races with symptoms of one year or more A curve of this

phenomenon seems to justify considering these two groups as representing two basically different types of malignancy It does not appear unreasonable to look upon the earlier group as representing carcinoma arising more or less as primary lesions and the later group as representing those cases which were engrafted on a precancerous lesion which remained essentially benign for some months at least

TABLE VI

DURATION OF SYMPTOMS

	White	Colored
Records in which duration of symptoms was not noted	17	20
Less than one month	11	14
1–2 mos	28	23
3–6 mos	26	42
6–9 mos	27	35
9–12 mos	3	9
1–1½ yrs	19	39
Over 1½ yrs	44	43
Average for those 1½ yrs or less	6 0 mos	7 2 mos
Average for those over 1½ yrs	5 9 yrs	5 3 yrs
Average for all	2 0 yrs	1 6 yrs
Percentage over 1½ yrs	21 2%	21 3%

TABLE VII

LYMPHATIC INVOLVEMENT

	White		Colored	
	No	Per Cent	No	Per Cent
Noted on physical examination only	59		86	
Noted on physical examination and history of patient	28		43	
Noted from history of patient	6		7	
Total with lymphatic involvement on admission	93	53 1%	136	60 6%

The above percentages of lymphatic involvement are another indication that the Negro patient seeks medical attention much later in the disease than do whites

It also indicates the lateness with which both groups, white and colored, apply to a public institution for diagnosis and treatment of malignancy of the breast

In the study of these cases 345 out of 481 had Wassermanns done Of the 208 Negro patients on whom Wassermanns were done, 187 were negative and 21 positive The negative incidence in the white race was 144 with only 2 positives The presence or absence of syphilis in this group would not indicate its presence as an exciting factor

TABLE VIII

INCIDENCE OF SYPHILIS

	White	Colored
Positive	2	21
Negative	144	187
Totals	146	208

TABLE IX

PREOPERATIVE ROENTGENOLOGIC EXAMINATION

	No Before Radical Operation	No Before Palliative Operation	No Before No Surgical Treatment
White	57%	54%	
	54 (94)	17	39
Colored	74%	69%	
	88 (118)	32	41
Totals	66%	63%	
	142 (212)	49	80

TABLE X

NUMBER OF ROENTGENOLOGIC EXAMINATIONS MADE BOTH PRE- AND POSTOPERATIVELY

	White	Colored
Before Operation		
Chest	95	153
Breast	13	31
Skull	0	1
Skeleton	22	1
G I series	4	2
After Operation		
Chest	19	27
Breast	1	2
Skull	0	1
Skeleton	6	7
None taken	58	57

The statistics in Table IX demonstrate a very low percentage of cases that had any roentgenograms taken before operation It is believed 57 per cent, the percentage of whites which were examined roentgenologically before

radical operation, represents an unfortunate circumstance In fact, there is no reason why every patient having either a radical or palliative operation should not have a roentgenogram of the chest taken as a matter of routine

More attention was paid in this series to possible metastases to the thoracic cage than other skeletal structures It is impossible to state how frequent actual skeletal metastases were from this study It is our firm conviction that more attention should be paid to roentgenologic values preoperatively than this group study indicates has been the practice

TABLE XI

BIOPSIES

	No	Followed by Radical	Primary Admissions Followed by Palliative	Primary Admissions Followed by No Surgery	Biopsy and Radical at Same Time	Radical 2 days to 9 wks after Biopsy
White	25	14	3	8	9	5
Colored	15	12	0	3	7	5
Totals	40	26	3	11	16	10

In this series, there was a total number of 40 biopsies, 26 were immediately followed by radical operations Of this number, 16 were done at the same sitting Ten radical operations were performed from two days to nine weeks following the biopsy No satisfactory explanation can be offered for the extreme delay of nine weeks It is our conviction, and we believe the consensus of opinion, that biopsies are of value when a satisfactory histologic report is given immediately and the radical operation proceeded with Further, we believe that it is the consensus of opinion that the histologic report of a frozen section is not always satisfactory

TABLE XII

SURGICAL TREATMENT

Operation	White	Colored
Radical operation	50	63
Palliative operation	15	20
Radical and radiation	44	55
Palliative and radiation	16	26
Radiation alone	30	29
No operation	21	27
Totals	176	220

Out of the total number of 399 cases, only 94 whites and 118 colored (total 212) were considered suitable, for radical operation (53 per cent) The remaining 47 per cent were considered too far advanced for anything

except palliative operation, radiation alone, or for no treatment whatsoever The high incidence of this latter group is further indication of the extensive involvement at the time the patients applied for admission

Of the total group, 44 whites and 57 colored were treated by a combination of radical operation and radiation Most of this radiation was postoperative Because of the fact that the colored patients come in late, it was felt that the delay necessitated by preoperative irradiation would jeopardize further the chances of success of any radical procedure

TABLE XIII

IMMEDIATE MORTALITY AFTER RADICAL OPERATION

	White	Colored
Number	94	118
Deaths	2	7
Percentage	2 1%	5 9%

The above mortality statistics reflect the comparatively low death rate immediately following radical operation, despite the fact that the operations were performed by many operators and some by house officers doing their first few cases of this kind

The difference in the death rate for the two races probably reflects differences in general physical condition during the middle and late decades of life

TABLE XIV

MORTALITY IN GROUPS WITH AND WITHOUT INVOLVEMENT OF LYMPH NODES THAT HAD RADICAL OPERATION

LYMPH NODES	White		Colored	
	No	Dead	No	Dead
Without lymph nodes (s)	43	12 (27%)	55	14 (25%)
With lymph nodes (c)	51	11 (21%)	63	29 (46%)
Totals	94		118	

Of 118 Negroes upon whom radical operation was performed (55 without nodes and 63 with nodes), there are 43 known dead, or 36 4 per cent

Of those having lymph node metastases, 46 per cent are known dead The status of 57 of these patients is not known, therefore, the actual mortality in this group must be much higher than 36 4 per cent as noted above for the whole group

There are in addition to the above at least 12 cases which we have not been able to trace, who are probably dead This would raise the mortality up to date to about 65 per cent from one to four years after operation

Even this we believe to be too low an estimate, when we consider the late period of admission and 60 per cent lymph node metastases at the time of operation

TABLE XV

PERCENTAGE OF KNOWN DEAD IN VARIOUS AGE GROUPS

DECADE	White			Colored		
	Whole Group	Known Dead	Per Cent	Whole Group	Known Dead	Per Cent
20–30	2	0	0	9	3	33
30–40	28	9	32	38	16	42
40–50	35	12	34	81	19	23
50–60	59	10	16	53	17	32
60+	51	11	21	43	11	25
Totals	175	42	24	224	66	29

Table XV shows that the largest percentage of known dead is in the fifth decade of life for the whites and the fourth decade for Negroes

At least 30 other cases which we have been unable to trace are probably dead This would increase the mortality for the total series of colored patients, irrespective of whether radical or palliative operation or no operation was indicated, to 43 per cent from one to four years after admission We feel that even that figure is too low We will continue to trace these patients, possibly at a later date more accurate data will be available

TABLE XVI

RELATIONSHIP BETWEEN NUMBER OF KNOWN DEAD AND DURATION OF SYMPTOMS

	White			Colored		
	Known Dead	Whole Group	Per Cent	Known Dead	Whole Group	Per Cent
Less than 2 mos	6	28	21	8	23	34
2– 9 mos	17	53	32	23	77	29
9–12 mos	2	3	66	5	9	55
12–18 mos	7	19	36	7	39	17
Over 18 mos	6	44	13	18	43	41

When the known dead are divided according to the duration of symptoms, it is seen that the mortality percentages increase as the duration of symptoms increases until the highest percentage of known dead is reached in the 9–12-month interval After that as the duration of symptoms lengthens, the percentage of known dead decreases This would seem to be additional evidence to substantiate the theory that these two groups differ basically It is difficult to escape the conclusion that those patients with duration of symptoms over

one year represent (a) A slow growing carcinoma, or (b) an early carcinoma in which the long duration is accounted for by a preexisting lesion essentially benign

I wish especially to express my appreciation to the President, Dr J A O'Hara, and Dr P A Kibbe and members of the State Board of Health for their cooperation, to the Superintendent of the City Board of Health, Dr J M Batchelor, for courtesies extended in allowing a member of the staff to study the records, to the members of Record Room staff, Charity Hospital and Sister Ignatius of the Tumor Clinic, Charity Hospital, as well as my secretary, Miss Giselda Napolitano, for the preparation of the statistical tables

REFERENCES

[1] Matas, Rudolph The Surgical Peculiarities of the Negro Tr Amer Surg Assn, 14, 483–606, 1896

[2] Hoffman, Frederick L Some Cancer Facts and Fallacies Reprint form, August, 1925

[3] Hoffman, Frederick L Cancer in Mexico Reprint form, Prudential Insurance Press, 1927

[4] Hoffman, Frederick L Cancer Among North American Indians, The Health Progress of the North American Indian, The Indian as a Life Insurance Risk Reprint form, Prudential Insurance Press, 1928

[5] Deaver and McFarland The Breast Its Anomalies, Its Diseases and Their Treatment P Blakiston Sons & Co, Publishers, 1917

[6] Maes and McFetridge Racial Trend of the Negro and White in Certain Surgical Diseases Am Jour Surg, 33, 5, 1936

[7] Smith, E C, and Elmes, B G T Malignant Disease in Natives of Nigeria An Analysis of Five Hundred Tumors from the Research Institute Lagos, July, 1934 Annals Trop Med and Paras, 28, 461, 1934

[8] Vint, F W Malignant Disease in Natives of Kenya Lancet, 2, 628–630, September, 1935

[9] Cohn, Clarence Carcinoma of the Female Breast Arch Surg, 35, 604–711, October, 1937

[10] Adair, Frank, and Stewart, Fred W The Value of Preoperative Irradiation in Breast Carcinoma ANNALS OF SURGERY, 102, 254, 1935

[11] McKittrick, Leland S Interstitial Radiation of Cancer of the Breast ANNALS OF SURGERY, 106, 631–644, October, 1937

[12] Hutchinson, R H The Value of Radiation Therapy in the Treatment of Cancer of the Breast Surg, Gynec, and Obstet, 62, 653, 1936

[13] Keynes, Geoffrey The Place of Radium in the Treatment of Cancer of the Breast ANNALS OF SURGERY, 106, 619–630, October, 1937

CARCINOMA OF THE BREAST

HUGH H TROUT, M D
ROANOKE, VA

DOCTOR TROUT, in view of the apparent divergence of opinions as to what constitutes a radical operation for carcinoma of the breast, showed a moving picture which demonstrated his conception of the Halsted operation

Appended is a very brief resume of certain conclusions that have been reached by a consideration of the histories and follow-up of 567 cases of carcinoma of the breast, which had been admitted to the Jefferson Hospital, Roanoke, Va., during the past 30 years

POSSIBLE ETIOLOGIC FACTORS

(1) Heredity Experimental research and clinical observations indicate that heredity plays an important rôle in malignancy

(2) Hormones While there is still much uncertainty as to the effects, if any, of the various hormones in the production of malignancy, nevertheless there is sufficient clinical evidence to justify irradiation of the ovaries in carcinoma of the breast

(3) Cystic Mastitis This condition is so prevalent, and the terminology so indefinite, that no absolute conclusions can be drawn concerning the association of this condition with malignancy However, there is no definite evidence that chronic cystic mastitis is a forerunner of malignancy of the breast

(4) Lactation Apparently there is some very definite association between "dysfunction" of lactation and the subsequent development of carcinoma of the breast

(5) Attachment of Breast The most frequent site of carcinoma of the breast is in the upper, outer quadrant of the breast This is also the site of the greatest traumatic insult by pendulous breasts constantly making traction at this point as the patient walks Chronic irritation produced by this method might play an important rôle in the development of malignancy in this locality

Prognosis—We believe that both the clinical and the histologic indices should be employed in order to obtain a more accurate estimate of the future of the patient

Treatment—As radiologists are not in agreement concerning the relative values of preoperative and postoperative irradiation, and also operative insertion of radon seeds, we feel all three should be employed, if such can be done without injury to the patient We further feel that there are distinct dangers inherent in each one of these three methods of irradiation, but that these dangers can be prevented by close cooperation between the surgeon and the radiologist We certainly feel irradiation has no replacement value to surgery, and should be employed only as an adjunct In other words, we

are quite confident that careful and extensive removal of the malignancy by surgery is still the most important factor in the cure of carcinoma of the breast

DISCUSSION OF THE PAPERS OF DOCTORS COHN AND TROUT

DR JAMES M MASON (Birmingham, Ala.)—I have been much interested in Doctor Cohn's statistics on cancer of the breast in colored patients in the city of New Orleans. For purposes of comparison I have made a brief analysis of admissions to the Hillman Hospital of cancers of the breast in white and colored patients over a period of five years beginning in 1933.

In those sections of the country where there is a large colored population, the question often arises as to the relative prevalence of various diseases in the white and colored races. It will usually be found that they suffer from the same illnesses, but that, owing to differences in social and economic status, the colored patient is the worse sufferer. In small communities and in rural districts where the colored population is not so well looked after at home, and where hospital facilities are meager or lacking, there is reason for anticipating a higher mortality from cancer of the breast in colored than in white patients. In larger cities, where hospital facilities are equally available for members of both races, the mortality should not show any great variation. When the variation is marked, it may be safely said that it is due to the ignorance of the colored patient concerning the early symptoms of cancer, and to the failure of educational measures to impress the colored sufferer regarding the necessity of early attention to suspicious lesions of the breast as well as of other parts of the body.

The Hillman Hospital makes ample provision for the care of both white and colored patients, and we find the appended figures for admission of patients suffering with cancer of the breast over a five year period beginning in 1933 (Table I).

TABLE I

RACIAL DISTRIBUTION OF CASES OF CANCER OF THE BREAST ADMITTED TO HILLMAN HOSPITAL, BIRMINGHAM, ALA., DURING THE FIVE-YEAR PERIOD (1933–1937 INCL.)

Total admissions for cancer of the breast		
Whites	40	
Colored	50	
Inoperable on admission		
Whites	8	20%
Colored	13	26%
Radical operations		
Whites	32	
Colored	37	
Deaths following operation		
Whites	2	
Colored	2	

We find, therefore, in our County Hospital, a larger number of admissions among colored women and a larger percentage of inoperable cases among colored women, which means an ultimately higher mortality rate.

DR LLOYD NOLAND (Fairfield, Ala.)—I am much interested in Doctor Cohn's figures, which differ somewhat from ours at Fairfield. Out of the total admissions of approximately 40,000 adult women, about evenly divided

between white and Negro patients, we have encountered 142 cases of carcinoma of the breast—89 cases in white women and 53 cases in Negroes, or 60 9 per cent in whites and 36 3 per cent in Negroes

DR A C SCOTT (Temple, Texas) —Aside from early operation, successful surgery of cancer of the breast is dependent upon two phases of technic First, the complete removal of all diseased tissue by wide excision, and second, careful removal of all node-bearing fat, without leaving the wound contaminated by active cancer cells It should be remembered, of course that any cancer cells left in a wound by careless or rough handling of diseased tissue may reproduce the disease, unless, during removal of the breast, they are heated to 135° F This is the reason we have placed so much emphasis upon the use of a hot knife instead of a cold one

After all, the value of any surgical technic is greatly enhanced by early, accurate, differential diagnosis in advance of operation Unfortunately, definite differential diagnosis between malignant and benign tumors of the breast is seldom made prior to operation without biopsy, except when one or more late signs of advanced disease are present I refer to adhesions of the tumor to adjacent breast tissue, to chest wall or overlying skin, retraction of nipple, marked dimpling, and enlarged axillary nodes, all of which should usually be considered late signs of cancer

Next to the presence of a tumor, the most valuable early sign of cancer may be observed by taking advantage of the fact that when cancer begins, there soon appears an increase of fibrous tissue running in all directions from the tumor mass The fibrous tissue represented in Cooper's ligaments, which extends from the glandular lobules of the breast, through the subcutaneous fat to the overlying skin, is increased sufficiently to reduce elasticity of the subcutaneous tissue When the tumor is moved in various directions, a dragging or pulling on the under surface of the skin may produce shallow dimples in the area of the tumor Such dimples may be wholly unobserved in a well-lighted room, but become readily visible when the rays of a spotlight are directed across the surface of the breast during manipulation of the tumor in a darkened room This, in my judgment, is the most valuable early sign of cancer

DR ELLIS FISCHEL (St Louis, Mo) —All studies on racial distribution of cancer cannot help but shed light on the whole problem of why some groups of people have cancer of one organ more than other groups We know the death rate from cancer is uniform The distribution by organs is, however, not at all uniform For instance, the death rate from cancer of the stomach in England is 50 per cent, while on the Continent it is 25 per cent Cancer of the cervix is rare in Jewish women, and yet the general death rate from cancer in Jews is just as high as in gentiles

With reference to cancer of the breast among Negroes, I have made a cursory review of this subject from the material available at the Barnard Free Skin and Cancer Hospital in St Louis This city has approximately 11 per cent Negro population, *i e*, 93,580 Negroes, 755,120 whites, in 1930 Barnard Hospital is a free hospital, open to both whites and Negroes During the last 25 years, 696 cases of cancer of the breast have been operated upon Of these, 577 were whites, 119, or 17 per cent of the total, were Negroes This is 6 per cent higher than the percentage of Negroes in the population of the city The ratio of general admissions to the surgical clinic is about 12 per cent Negro From our figures we can judge that there is a slightly greater incidence in cancer of the breast among Negroes than in a corresponding cross-section of the white population

It would be interesting if there were any way in which we could discover the relative frequency of cancer of the breast in uncivilized Negroes corresponding cross-section of the white population

Doctor Cohn's figures bring out clearly the problem of education The elapsed time between first appearance of a noticeable lump and visit of the Negro to the physician is truly deplorable If I remember Doctor Cohn's statistics, it was something around 20 months in New Orleans In Massachusetts, where lay education has been emphasized for many years, the period of delay for the general population had, in 1936, been diminished to five months

From a treatment standpoint, we can expect 80 per cent five-year cures in cases operated upon before there is microscopic evidence of metastasis in the lymph nodes However, after metastases occur, the percentage of favorable five-year results will be 30 per cent at the best, and probably lower

I believe that it is advisable to make the skin incision two inches beyond the palpable limits of the tumor in order to minimize recurrence in the skin flaps I do not irradiate before, during, or after operation

DR L WALLACE FRANK (Louisville, Ky) —Relative to the preoperative irradiation of cancer of the breast We are seeing many more carcinomata of the breast than formerly, and in our private work have operated upon an average of 25 cases each year for the past six years

We are employing preoperative irradiation in those cases where the clinical diagnosis of malignancy is evident The one objection to preoperative irradiation is that with the disappearance of the tumor the patient is lulled into a false sense of security and may not return for subsequent surgery We believe that all patients having malignancy especially of the breast and cervix should be told the nature of their disease After this is done one can easily explain to the patient why different procedures are employed and much greater cooperation and understanding is established between the patient and the doctor It is true that one meets individuals whose nervous make-up is such that the true status of affairs cannot be told them However, such instances are rare After the patient is told the nature of the disease and the reason for giving preoperative roentgenotherapy, and is also told that the treatment is not curative but is simply one step in the method of combating the disease, and that radical surgical removal of the breast must eventually be employed if cure is expected, then there is no difficulty about influencing the patients to return for observation and operation

The benefits of preoperative roentgenotherapy should be explained to the patient, namely, that the tumor may be reduced in size, and that in sterilizing the early lymphatic involvement the likelihood of squeezing cancer cells beyond the operative zone while the actual operation is being performed is reduced to a minimum

DR MIMS GAGE (New Orleans, La) —Regarding the type of wound closure and postoperative dressing which we have been using in our clinic, following the radical surgical treatment of breast cancer We believe that the use of unabsorbable suture material facilitates wound healing and reduces wound exudation Therefore, in all of our cases we employ silk for both ligatures and sutures I personally use No 40 spool cotton thread for all ligatures

After thorough hemostasis, the wound is closed without tension As shown by Doctor Trout, sufficient skin can be obtained from the breast without fear of local recurrence, to enable skin flap closure without tension As we have two large full thickness grafts of the Wolf-Krause type to cover the

exposed chest wall, it is necessary to coaptate the flaps against the chest wall in order to secure successful and rapid healing The method used to obtain healing of these two large skin flaps differs in no way from the methods used in plastic surgery, that is, the use of pressure on the flaps sufficient to obliterate all dead spaces, prevent capillary oozing, and tissue secretion, and promote rapid agglutination of the flaps to the chest wall, which results in rapid healing with pliable skin This is obtained by the use of sea sponges applied to the flaps over a base of sterile gauze The wound is, therefore, not drained The dressings as a rule are not changed for ten to 12 days, however, if it becomes necessary the dressings may be changed and fresh sponges reapplied We have used this method in six cases with excellent results The wounds in these cases were completely healed in 12 days

DR J L CAMPBELL (Atlanta, Ga) —For ten or 12 years, I had charge of the Surgical Service at Grady Hospital, during which time I paid particular attention to breast cancer For the last eight years the service was limited to Negroes in the Emory University division of the hospital

There were 102 carcinomata occurring in breasts of Negro women In one case the lesion was bilateral In five or six it was of an inflammatory type, the breast and surrounding area was densely infiltrated, the skin thickened and of an orange-peel appearance Radiation had no effect whatsoever, however, in the last inflammatory case we gave sterile milk, just as is done in acute pelvic peritonitis, and it seemed to arrest the progress of the disease This woman was watched for about a year before she was lost sight of, during which time the breast decreased in size and became fibrous and board-like So far as the other patients are concerned, their conditions followed closely the characteristics described by Doctor Cohn, except that the age of Negro women averaged 42 1 years, while in a series of 50 white women studied five or six years ago it was 49 7 years—the difference in incidence being 7 6 years instead of 4 7 as in Doctor Cohn's series

As to the technic outlined by Doctor Trout, I agree with him in the manner of securing the biopsy I prefer, however, to make my dissection of the axilla first A modified Rodman incision is made, taking great care not to touch the deep fascia, the pectoralis major and minor muscles are then cut across close to their insertion A sharp scalpel is used, and never under any circumstances is any blunt dissecting done, as we believe that by this procedure there is great danger of pushing the cancer cells out of the lymph channels We try to include in the skin removed with the breast, that over the large lymph channel that passes across the outer border of the pectoralis muscle and a much larger area is usually removed than Doctor Trout has illustrated If one loosens the skin flaps sufficiently there will be no trouble in approximation, especially if we use figure-of-8 tension sutures at about three points The technic so far as the skin incision is concerned cannot be followed in every case, but must vary with the location of the lesion However, the axilla can always be dissected first and the vessels ligated before they are cut In my experience we will then have much less bleeding in removal of the breast proper, in fact, we get practically none until we reach the area supplied by branches from the internal mammary artery

DR ISIDORE COHN (New Orleans, La) in closing —It is interesting to learn that the statistics from Birmingham so nearly agree with our own I think that the reason for the difference between Doctor Mason's and Doctor Noland's statistics is that Doctor Mason's statistics are taken from a general

community hospital of the same type as the Charity Hospital in New Orleans, and Doctor Noland's figures are from a selected group of the population

With reference to the mention of the use of cotton thread by Doctor Gage, I wish to state that I saw Mr Pierce Gould operate at Middlesex Hospital in London and I noticed that he used cotton thread I was curious to learn why He replied, 'I saw my father use it, and one usually imitates the person for whom he has the greatest admiration I have used it ever since and I have had no trouble" I am pleased to learn that it is being used to advantage in our own country

Concerning the appearance of carcinoma in various organs among racial groups, there are several very interesting studies which have recently been made From the recorded experiences from Africa we note that carcinoma of the breast forms a small percentage—only 9 per cent—of all the malignancies noted by Vint in his studies, while carcinoma of the liver was responsible for 13 7 per cent of the cases

With reference to preoperative irradiation, I should like to say again, that I felt that delay necessitated by such treatment was undesirable in late cases, particularly in individuals of the type analyzed in our presentation

DR HUGH H TROUT (Roanoke, Va) in closing—In reply to Doctor Gage's question concerning drainage, we remove the drain within 24 hours after operation By this method we have never had any of the troubles of which he speaks concerning the use of drainage, and I think we have possibly prevented the accumulation of some little serum under the skin, which would have interfered with healing I believe that the sea sponge strapped close to the side, which approximates the skin to the chest wall and keeps it there, especially in the axilla, contributes much to a successful and satisfactory healing

The case demonstrated in the motion picture was a very early malignancy, and, for that reason, not as much skin as is usually removed was removed in this particular case In many of our cases we remove so much skin that it is necessary to apply Thiersch grafts taken from the thigh However, the size of the skin flap depends largely upon the extent and location of the malignancy Our tendency is to remove far more skin than was illustrated

A SIMPLE TREATMENT FOR EMPYEMA IN CHILDREN

BYRD CHARLES WILLIS, M D
ROCKY MOUNT, N C
FROM THE SURGICAL SERVICE, PARK VIEW HOSPITAL, ROCKY MOUNT, N C

IN 1931, the writer[1] reported 51 cases of empyema in children under 13 years of age Since then there have been 53 other cases of similar age admitted to the Park View Hospital, all of which were treated by the trocar-punch operation, and in only one instance was a secondary rib resection found to be necessary

Since the two groups are so similar they have been combined for statistical purposes This present paper is, therefore, based upon a study of 104 consecutive cases, from October 15, 1915, to October 15, 1937, all of which have been operated upon by my associates, Dr E S Boice, Dr N P Battle, or myself They have all been handled in the same manner and the treatment has varied but little

Many authors have expressed a very decided opinion in favor of rib resection Heeks[2] states "Of all those patients at babies' hospitals who were treated with closed drainage, only 5 per cent recovered without rib resection" Donovan[3] states "Children under five years of age are practically the only age-group whoever completely recover without final rib resection"

These two statements are not at all in accord with my experience and that of Packard, Jr ,[4] who says that "Closed drainage apparently meets its greatest indication in children" Downes,[5] reporting a large series, says "Intercostal incision is the general method of operation for which I would put in a strong plea" Douglas,[6] discussing the occurrence of chronic empyema in 48 acute cases, says there were none in his series of partial rib removal and closed drainage This is in agreement with my experience in the employment of punch thoracotomy

Farr and Levine[7] show in Table IV of their report, 22 cases of secondary operations after open operation in 596 patients This total was arrived at by combining 226 cases of Ladd and Culter and 371 from St Mary's and the New York Hospital Therefore, the open method is not without its failure to cure following the first operation He also quotes Binney, noting his experience with the closed method, which showed a very high percentage of secondary operations (42 per cent) in a combined group of 75 cases

Fitzgerald[8] used a closed method, as advised by Denis Browne, that will reexpand the lung in five days His mortality was 11 per cent, this is low, but I cannot subscribe to so early a removal of the tubes Hudson, Jr [9] cites that out of 32 patients with intercostal drainage 14 required rib resection Unfortunately, he does not state the number of days elapsing between intercostal incision and rib resection It would appear that sufficient trial was not given

the method, because, with the two operations, the patients spent only 48 days in the hospital Packard, in his series, states average duration of drainage to be 46 1 days In my cases it averaged 54 2 days

Steinke[10] had 295 children under eleven years of age, with 22 per cent mortality He does not state the method used in this group but in his conclusions says "The lowest mortality, by far, follows rib resection" On the same age basis, we had 79 cases who had trocar-punch with four deaths, over 5 per cent Of course he may have had proportionately many more under two years, which would increase his death rate, though hardly 300 per cent more

Graham, quoted by Mason,[11] favors rib resection after the empyema has passed to the stage of abscess, though he further states "So far as mortality is concerned, it makes no difference whether the case is treated continuously by some form of closed drainage" Mason does not subscribe to the latter statement, neither do we

Farr and Levine conclude that "The various methods of treatment now in use—the use of the intercostal incision or rib resection, open drainage or closed drainage, Dakin's solution or simple drainage—seem to have little influence upon the prognosis" Fitzgerald has found that "Rib resection with open drainage is easy, quick, requires no special apparatus and little further care, but it carries a risk of chronic empyema with infected pneumothorax, with its sequelae, permanently collapsed lung, infected fistula, osteomyelitis of the ribs, if employed too early in the course of acute, total empyema"

If the above should happen, scoliosis would undoubtedly follow When collapse of the lung occurs there is inaugurated circulatory and pulmonary embarrassment, which results in an increasing mortality

Hart[12] uses closed drainage with tidal irrigation, which means the child is largely confined to one position, and in young children would require a constant attendant, as some very young children remove their dressings, necessitating elbow cuffs It is not an uncommon sight to see them sitting up in crib the day following punch thoracotomy

I believe that the punch operation carries a lower mortality, if these little patients in the after treatment are given the attention necessary to keep their cavities clean and improve their general health The attendant must be well trained in all the maneuvers necessary to get rid of fibrinous flakes through these small tubes The intern or nurse should be thoroughly interested in cleaning out the cavities, and a careful record should be frequently made as to their capacity

There is no question that it is more difficult to treat these patients by this method than by placing a large tube in the chest through an opening effected by resecting a rib, but lower mortality, freedom from postural changes, unsightly scar and pus soaked dressings should compensate both the patient and the surgeon There is a general opinion that chronic empyema results much more frequently from this method than from rib resection, but such has not been our experience We have seen none in children treated by us

In the 86 adult cases, there was one which was thought to be secondary to emphysema, and there were two chronic empyemata following rib resection by other surgeons None of the three had tuberculosis

In this series of 104 cases only a few originated in the hospital Since the disease rarely occurs as a primary lesion, a careful history must be obtained, especial attention being paid to the possibility of antecedent pneumonia There was a history suggestive of a broncho- or lobar pneumonia in 103 cases In two it followed influenza, in three measles One patient aspirated a raw peanut into a bronchus

The diagnosis of empyema in referred hospital cases is rarely difficult since the symptoms and signs are usually definite before the patient is admitted and the correct diagnosis has usually been made or suspected

Fluoroscopic examinations before and after operation are most important, the former to detect the disease and its extent, the latter to watch the progress of the treatment

Whenever pus is found in the pleural cavity, without the presence of pneumonia, we believe the wisest procedure is to drain through a small rubber tube by the closed method A rib resection, certainly in the sympneumonic stage, is in our opinion, dangerous surgery, and often the cause of a fatality

The thoracic-puncture is a simple operation attended with practically no shock

Method of Procedure—The field is first painted with iodine, a point is selected, usually the eighth or tenth interspace, in the posterior axillary or scapula line, unless there is a localized pocket Infiltrate the skin for three-fourths of an inch, carry the infiltration down to the pleura, change the needle for a larger one and introduce it into the pleural cavity, aspirate pus, disconnect the syringe, and make a one-half inch incision through the skin and deep fascia beside the needle in the line of the intercostal space Introduce the trocar directly into the pleural cavity so as not to injure the diaphragm Pull out the obturator, introduce the fairly rigid special tubing about 5 Mm in gross diameter, with lumen 3 Mm It should be twice the length of the cannula and fit snugly, with no opening on the side, and introduced from three to four inches so as to reach well beyond the walling-off process of the cavity The tubing should be rigid enough not to collapse when suction is made with syringe An added advantage in leaving it long is that when the tube is blocked by a plug of fibrin it can be cleared by solution introduced, shifting the tube, and drawing the pus from another level If too large tubing is used pressure on intercostal nerve may result If the child is not very sick we practically evacuate the pus while the cannula is in position, and in this way get rid of many large flakes of fibrin This should not be done if there is a large accumulation, but the pus should be removed at intervals in order not to reduce the intrathoracic tension too rapidly Coughing is an indication to stop Then the cannula is withdrawn somewhat The sudden reduction of tension in very sick children in rib resection is, I believe, the chief cause of high immediate mortality, and deaths occurring in a few days are probably due to too great loss of vital capacity

We apply an air-tight dressing consisting of three square inches of rubber tissue made from the wrist of an old glove, punch a hole in the center with pointed forceps and thread rubber tissue over the tube down to the chest wall The sides of the rubber tissue are then sealed down to the chest wall with adhesive The tube is anchored by tying it close to the rubber tissue, and these ends are tied over adhesive strips that are brought up close to the tube The tube is doubled upon itself and tied off, if it is desirable, so that the intrathoracic pressure may be reduced gradually by evacuating small amounts of pus at intervals There are other adequate means of maintaining the tube in place The tubing should be of sufficient size to just fit cannula or leaking will occur around the tube

If there are many fibrin flakes in the pus, one must use great patience and persistence to maintain drainage We treat our cases by both the open and closed method

If there are no fibrin masses one can readily remove the contents of the cavity by suction and leave a negative pressure in the chest, which may aid in obliterating the cavity Irrigations with Dakin's solution are employed after operation, when there are many plugs, but not until at least two days have elapsed, sometimes longer, depending upon the general condition of the child

If the patient leaves the hospital with the tube in position, the parents and doctor are urgently requested not to remove it They are not discharged until frank pus has disappeared and the general condition is satisfactory Over 10 per cent of the last 53 cases received one to three blood transfusions The local doctor irrigates the cavity on alternate days The patients usually return at weekly intervals for irrigation The tube is shortened according to the capacity of the cavity and the fluoroscopic findings It is removed only when the cavity holds less than 2 cc (that amount about fills the tract) and chest is fluoroscopically negative for any further collections The cavity must be obliterated before the tube is permanently removed If it is removed before the cavity is obliterated, though thought to be sterile, there will be a high percentage of recurrence, and some cases of chronic empyema will result

There were 61 males and 43 females The right side was involved in 44, left in 59, and bilateral in one

TABLE I

AGE INCIDENCE AND MORTALITY

Age	No of Cases	Mortality
Under 1 yr	4	2 died
1 to 2 yrs	17	2 died
3 to 5 yrs	31	1 died
6 to 10 yrs	43	No deaths
11 to 13 yrs	9	No deaths

Ninety cases occurred between December and May, inclusive Fourteen in the remaining six months were about equally distributed The bacteriologic findings are noted in Table II

TABLE II

Infecting Agent	No of Cases
Pneumococcus	58
Streptococcus	3
Staphylococcus	3
Mixed infection	3
Negative cultures	16
Not recorded	21
	104

Operations 16 had rib resections, only one among the last 53 cases, and this was because of inability to keep the tube in at home, 88 by trocar-punch Several received preliminary aspirations but were not treated with the expectation of cure by this method alone In only one child was complete collapse of the lung noted This case had a bilateral myringotomy for otitis media and left the hospital after 54 days The lung was completely expanded 37 days later, according to fluoroscopic examination, and the tube removed

In 95 the operation was performed under novocain anesthesia, nine under ether (early cases) The average stay in the hospital was 22 5 days Many of the charity cases were kept longer than necessary on account of home conditions and inability to return to the hospital at intervals The average leukocyte count in 64 cases was 27,000 In the group of 53 cases, since the 1931 report,[1] the time the tube remained in was stated in 45 (three died and five are not recorded), the average number of days was 54 2 Practically all of the pneumonia cases developed before hospitalization and an average of

TABLE III

ANALYSIS OF THE FIVE CASES WHICH DIED

Age in Months	Type of Operation	Cause of Death
24	Rib resection	Right rectus 1 mo (Appendicectomy) previously elsewhere, wound draining pus
		Unrecognized pneumonia with secondary empyema
		Extreme malnutrition
12	Thoracotomy-punch	Removed from hospital one day after operation without consent, returned 5 days later with tube out, in moribund condition
40	Preliminary aspiration	Bilateral pneumonia 1 mo age
	Thoracotomy-punch	Bilateral empyema
		Autopsy
30	Thoracotomy-punch	Pericarditis with effusion
		Lung abscess
		Pneumonia, right lung
		Peritonitis
		Subacute nephritis
		Small amount fibrinous exudate, left chest
5	Thoracotomy-punch	Bronchopneumonia
		Otitis media
		Meningismus

24 6 days elapsed before operation (shortest, nine, longest, 70) Approximate time between onset of empyema to operation was 14 4 days (shortest, two, longest, 60)

The postoperative treatment such as chest exercise, calisthenics, and bottle blowing should not be neglected, fresh air, regular rest, generous diet, cod liver oil or vitamins should be prescribed and carried out

Table III gives a brief resumé of the five cases that died, showing the age of patient, type of operation and principal cause of death

CONCLUSIONS

(1) Empyema cases should be diagnosed and treated early by aspiration and thoracotomy-punch for early cure

(2) The most valuable four clinical signs are dulness, absent or diminished fremitus, diminished expansion, and displacement of the apex of the heart

(3) The free use of roentgenograms and fluoroscopic visualization are indispensable aids in diagnosis and treatment

(4) Rib resection in children should be abandoned except in rare cases and then only after aspiration or thoracotomy have been thoroughly tried

(5) Intrathoracic tension should be gradually reduced

(6) The thoracotomy tube should not be removed until the cavity is obliterated

(7) These patients treated by thoracotomy require close attention of skilled and interested attendants

(8) Blood transfusions are life-saving in debilitated children

REFERENCES

[1] Willis, B C Diagnosis and Treatment of Empyema in Children Southern Med Jour, 24, 785–790, September, 1931

[2] Heeks, William G Proc Amer Acad Pediat, Jour Pediat, 7, 605

[3] Donovan, E J Proc Amer Acad Pediat, Jour Pediat, 7, 605

[4] Packard, G B, Jr Empyema in Children Surg, Gynec, and Obstet, 53, 255–258, August, 1931

[5] Downes, R M Treatment of Empyema in Children Med Jour Australia, Sydney, 2, 190–212, 1927

[6] Douglas, B Partial Rib Removal with Closed Drainage in the Treatment of Acute Empyema in Infancy and Childhood Reprint

[7] Farr, C E, and Levine, M I Empyema in Children Surg, Gynec, and Obstet, 46, 79–86, 1928

[8] Fitzgerald, R R Acute Empyema in Infants and Children Canada Med Assn Jour, 21, 479–485, November, 1934

[9] Hudson, H W, Jr The Treatment of Acute Empyema Thoracic in Children, Report of 86 Cases New England Jour Med, 22, 853–859, May 1, 1930

[10] Steinke, C R Acute Empyema, Comparison of Results in Children and Adults Ohio State Med Jour, 30, 813–815, December, 1934

[11] Mason, J M Empyema in Children, with an Analysis of 103 Cases Southern Med Jour, 28, 219–224, March, 1935

[12] Hart, D Empyema in Children, Report of 36 Cases Treated by Tidal Irrigation and with Suction Southern Med Jour, 23, 823–829, September, 1930

THORACOPLASTY IN THE TREATMENT OF PULMONARY TUBERCULOSIS

L. WALLACE FRANK, M.D., AND PAUL TURNER, M.D.

LOUISVILLE, KY.

FROM THE HAZELWOOD SANATORIUM, LOUISVILLE, KY.

WE BEGAN our work in the surgical treatment of pulmonary tuberculosis in 1926, shortly after the publication of John Alexander's book, and our experience with thoracoplasty may be divided roughly into three periods. We performed many phrenicectomies and the result of our first 100 cases was reported in 1929. Since then we have ceased to perform avulsion or section of the phrenic nerve but prefer to employ the crushing procedure. Formerly we usually accomplished the operation upon the nerve previous to applying the collapse therapy which involved some type of operation upon the ribs. In 1926, when we began the surgical treatment of tuberculosis, it was in its infancy in this country. Archibald had reported a fairly large series of cases, but in the United States the total number of thoracoplasties was exceedingly small.

The first group of cases falls in the period between the years 1926 and 1931 or 1932. As I review the results of our work during that period, I must frankly admit that I am greatly disappointed. I thought our results had been very good. They have been, insofar as the immediate mortality was concerned. However, in considering the end-results some ten years later we find that they are on the whole very poor. At that time, most of the cases that were referred to us were in the last stages of the disease and as one looks back on it the reason presented to these patients to consider operative treatment was the fact that it was the "only out." The medical adviser probably said, "You are in an advanced stage of this disease, all other methods have been unsuccessful. There is a possibility that by undergoing a surgical operation you may be able to return to your place in society, if you are not operated upon you might live a number of years provided you will remain in the sanatorium."

Unfortunately, due to the fact that we have been unable to check up on all of this group, the exact figures are not available, nevertheless, an estimate of the mortality would be about 80 per cent. Of the total number it might be stated, offhand, that between 80 and 90 per cent of them were far advanced cases. By far advanced, it is meant that the disease had been primarily in both lungs and that although those coming to operation were considered as unilateral cases, nevertheless, there had been disease in the other side, and in the years that followed operation a recrudescence of the disease occurred in the only remaining lung, causing death. Among this number there were a few cases that could be considered good risks, and all of these patients are

well to-day Of those that died it might be stated that a great number lived for three to five years and some longer Their death is not to be considered the result of the operation A large number of these individuals had intestinal or laryngeal tuberculosis and whether or not they died as a result of the disease in the lung cannot be ascertained Many of them had returned to society and many of them were married women and bore one or more children following their operation All eventually died of the disease for which the surgical procedure was attempted and, therefore, should be considered failures, insofar as any curative effect of the operation is concerned There were three hospital deaths

FIG 1 FIG 2 FIG 3

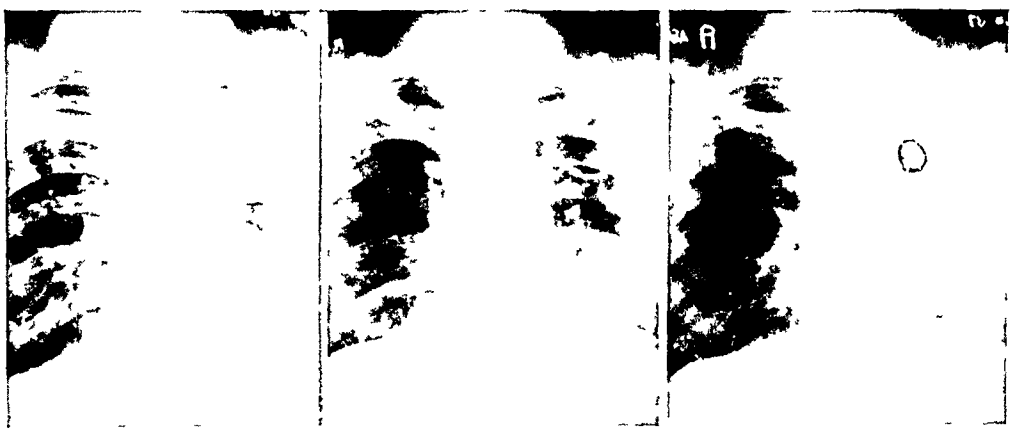


FIG 1—C C Far advanced bilateral tuberculosis for more than three years Under treatment for two years Bed rest and shot bags The right side cleared
FIG 2—C C Cavity developed in the left apex which became progressively larger Thoracoplasty was delayed on account of the size of the individual and the fact that he was considered to have myocardial disease
FIG 3—C C First stage thoracoplasty by method of Semb Cavity much smaller Apex of pleura at level of fourth rib

There are almost 20 per cent of these patients alive and most of them after eight years One, a female, came in to see me six months ago on account of pain in the left chest and thought she had a recurrence of her tuberculosis She looked perfectly well, and told me that, during the winter of 1936–1937, she had had pneumonia in her good lung but had made an excellent recovery Roentgenologic examination revealed the left chest to be perfectly clear

Our second group of cases dates from 1932, when we began to perform selective thoracoplasties The chief indication for operation was the same as it was in the first group—that is, the closure of cavities Among the second group, however, there were two or three cases in which the indication for operation was pulmonary hemorrhage These patients belonged in that class that had pleural adhesions and it was impossible to collapse the lung by a pneumathorax Their outlook was bad, nevertheless, we felt that thoracoplasty might not only control the hemorrhage but possibly cure, or arrest, their disease Thoracoplasty was performed in these cases, with the result

that all of them recovered and all but one are considered patients in whom the disease is arrested, the unarrested case is working part time

Before going farther it might be well to review the indications for thoracoplasty In our minds there are four First, the closure of the cavities, when the predominant lesion is in one side The term "predominant lesion" is used advisedly because all of the patients that have an advanced tuberculosis in one lung and relatively nothing in the other lung cannot be considered unilateral cases They may have unilateral tuberculosis as far as one can determine either by physical or roentgenologic examinations Nevertheless, when one considers that it is not a unilateral disease, it is difficult to discount the fact that a bilateral involvement may exist This, I think, explains our bad results in the first group Secondly, we believe that some type of thoracoplasty should

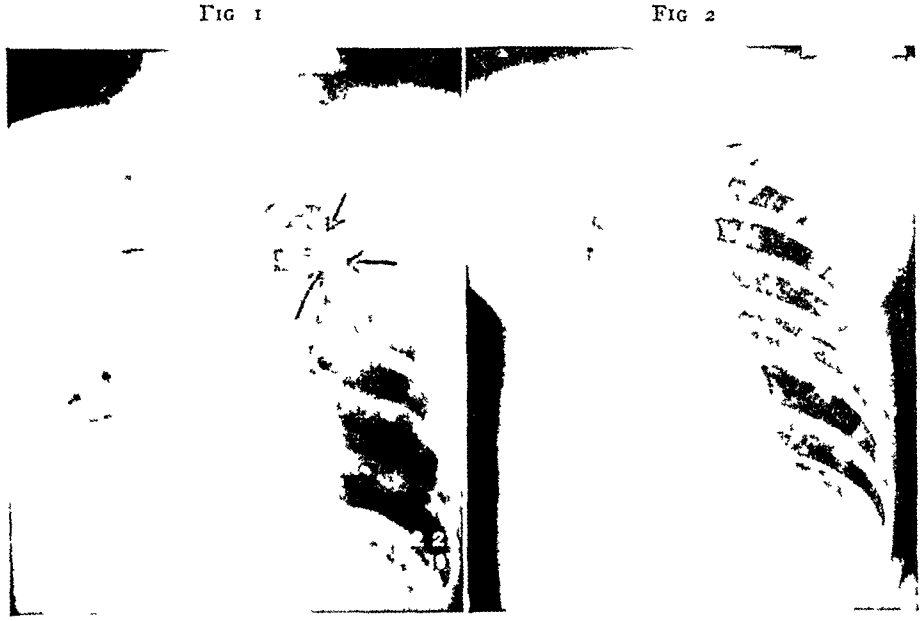


FIG 1 FIG 2

FIG 1—L T Admitted to the hospital October, 1933, on account of hemorrhage Had a pneumothorax for three or four months which on account of adhesions, did not control the hemorrhage Developed pleurisy with effusion Patient far advanced case with cavitation in the left lung

FIG 2—L T Thoracoplasty controlled the hemorrhage The left lung fields became clear Working full time

be employed in cases of bilateral apical involvement when the cavities are small In such cases careful determination of the vital capacity should be made, and especially when there is much fibrosis, in order that by operation the vital capacity may not be reduced to a point incompatible with life Third, we have employed this procedure in cases where the disease was progressing and in which other types of collapse therapy have been unsuccesful We have performed this operation upon two such individuals, and although one had had a spread in the good lung, the disease became quiescent after his operation Lastly, thoracoplasty may be employed to control hemorrhage

Recurring to the second period of our experience, the cases we had during that time were almost as bad as those in the first group It has been called the second period because during this time we were taking out all of the first

rib, all of the second rib and were performing the operation which Johns described in 1935 He called it "selective thoracoplasty," and possibly this is a good designation, inasmuch as most of the cases we see have apical involvement and, therefore, the removal of all or of large segments of the upper ribs accomplished the desired effect The name "selective" is also applicable because we collapsed only so much of the lung as was found necessary to close existing cavities Up to that time, that is two or three years before Johns read his paper, all our cases were late ones and total collapse of one side of the lung was essential to arrest the disease We were now getting our cases a little earlier, and in many the removal of three, five or seven ribs sufficed to collapse the lesion, and we were able to preserve one-fourth or one-fifth of that lung for purposes of respiration

FIG 1 FIG 2

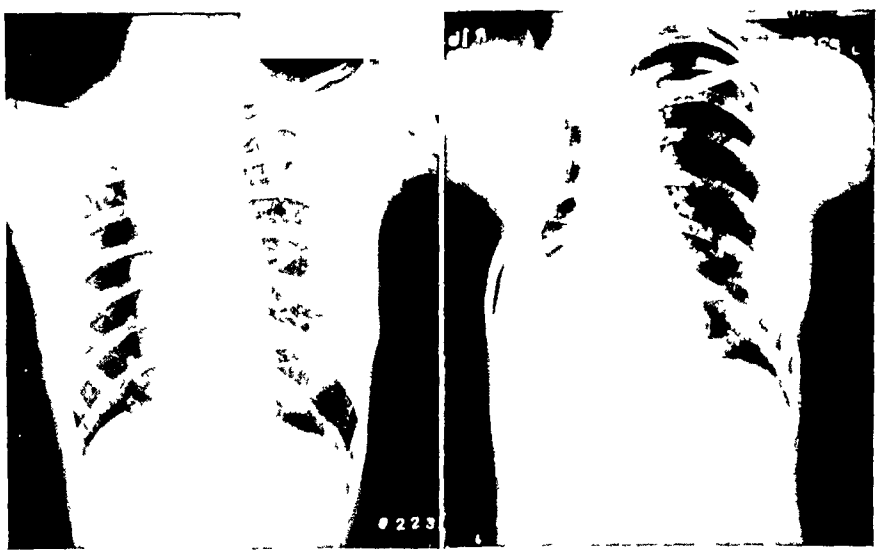


FIG 1.—M E Admitted to the hospital 1935 Sick more than two years Never took effective treatment Did have pneumothorax which was later withdrawn and oleothorax substituted, with the idea that continued pressure would close the cavity This failed and the oil was withdrawn

FIG 2.—M E Following thoracoplasty—five ribs resected Small cavity in the vertebral gutter Tubercle bacilli present, although patient apparently well and working In this case the cavity shown in Fig 1 could probably have easily been closed by the Semb type of operation

Our results in this group of cases have been relatively good, not so much on account of the pulmonary involvement but largely due to the fact that the collapse was greater than in the first group Our good results are, apparently, due to the fact that we were now taking out larger segments of ribs I can well recall the time when we were satisfied to remove one-half, three-fourths or an inch of the first rib and corresponding segments of the second and third During our so-called second period we took out all of the first rib from the lateral process of the first dorsal vertebra around to the sternoclavicular joint, and at this time we were likewise dividing the scaleni muscles and also the origin of the upper attachment of the serratus magnus It was

only after the division of these muscles that we were able to take out larger segments of ribs

The results following thoracoplasty of the patients which are grouped in our second period have been relatively satisfactory There are 33 cases which are to be considered, of these 17 have remained well from one to six years

FIG 1 FIG 2

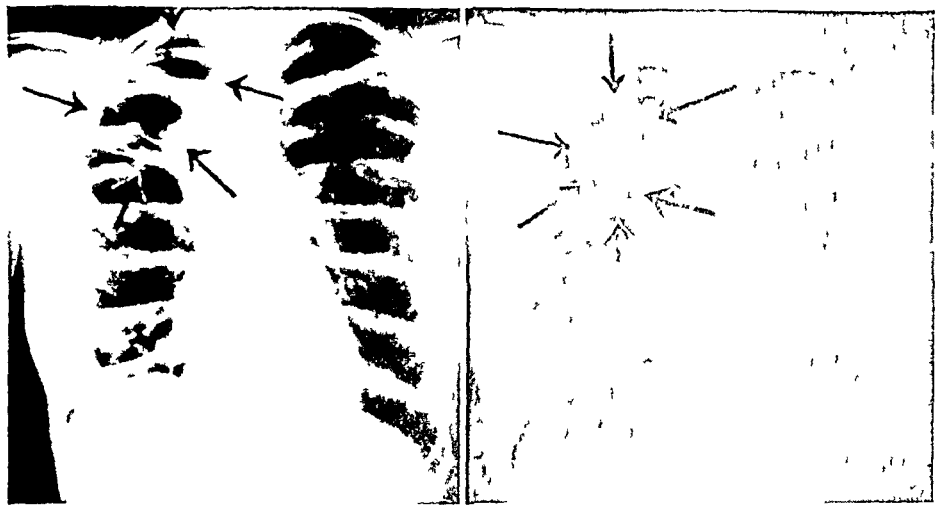


FIG 1.—Mrs J Shows two large cavities in the right apex Infiltration throughout the right lung field and possibly slightly in the left
FIG 2.—Mrs J After pneumothorax Cavities unchanged Apex of lung partly fixed near the third rib Base easily compressible Left lung quiescent

FIG 3 FIG 4



FIG 3.—Mrs J Following first stage of Semb procedure Apex of pleura just above fourth rib Cavities half former size Recrudescence in the right base Left lung still clear
FIG 4.—Mrs J Complete closure of cavities after removal of eight ribs The right base clear

The word "cured" is not used because this cannot be applied to tuberculosis any more than it should be applied to the result of the treatment of malignant disease So far these patients are well (carrying on) and living normal lives, and while possibly not cured, their disease should be considered arrested Eight additional cases are considered to be quiescent, that is, they are living

practically normal lives but occasionally when their sputum is examined tubercle bacilli are found (these are not found at every examination) In addition there are eight that have died Two died in the hospital, one as a result of heat prostration and the other following a secondary operation for the closure of a tuberculous empyema

In addition to the two cases just mentioned six more are dead, one following an operation for kidney stone As has been previously stated, most of the cases that come to surgery have bilateral involvement, the other five died due either to a spread into the other lung or to recrudescence of the disease in the other originally affected lung

One of the great advances in the surgical treatment of tuberculosis was presented, in 1935, by Carl Semb,[1] in his operation of "Thoracoplasty with Extra Fascial Apicolysis" For 12 or 15 years thoracoplasty with other forms of compression therapy had been widely employed in the treatment of pulmonary tuberculosis This operation, posterior thoracoplasty, was introduced by Sauerbruch and Wilms and was popularized in this country following the publication of "The Surgery of Pulmonary Tuberculosis," by John Alexander The old operation, namely, that which was considered in our first period, consisted in the removal of greater or lesser, and usually lesser, segments of the rib subperiosteally through a posterior approach We soon learned that the removal of the small segments of the rib did not produce adequate collapse and obliteration of existing cavities This can be appreciated when one considers the fact that following the removal of such segments, there was still enough rib left to hold up the parietal pleura and prevent the collapse of cavities if intrapleural adhesions between the lung and the parietal pleura existed Following the introduction of newer surgical methods, greater lengths of ribs, as a matter of fact the entire first, second and third rib with large portions of the other ribs were removed This has been adequately described by Carter, Johns and others Nevertheless, following such extensive operations apical cavities often were not closed If one considers the anatomy of the chest and realizes that the bodies of the vertebrae project into the chest cavity and the transverse processes of the vertebrae and the attached ribs come out rather far, it can be easily understood that even though the rib was removed back to the transverse process there is still a part of the lung in the vertebral gutter which is not compressed Following the removal of the ribs the collapsed side fell downward and inward and round cavities became oval, the smaller ones usually obliterated

The obliteration of tuberculous cavities within the lung is obtained, when pneumothorax is employed by the actual pressure of air and in these cases, as a rule, no adhesions can exist about the region of the cavity because such adhesions will hold the lung up towards the chest wall and prevent its collapse The best results are obtained where no adhesions exist and where following the introduction of air the entire lung collapses The collapse of the lung is not only from the lateral wall of the chest toward the mediastinum but from the apex downward It is rare, indeed, that sufficient air is intro-

duced into the pleural space to cause positive pressure Only a sufficient amount of air is introduced in artificial pneumothorax to bring the negative pressure, normally existent in the interpleural space, to zero Following the introduction of this amount of air in those cases where there are no adhesions, the normal elasticity of the lung causes its contraction from every direction and hence the cavity is obliterated

Carl Semb,[1] of Sweden, realized that this elasticity of the lung was a big factor in the obliteration of tuberculous cavities His experience with other types of operations had been the same as ours and being dissatisfied with the results obtained he devised a new method of thoracoplasty In brief, his procedure is as follows the usual method of subperiosteal removal of the ribs is employed and in his first stage of the procedure the first, second and third ribs are removed He disarticulates the ribs from the transverse processes of the vertebrae and removes the ribs much closer to the vertebral body Part of the transverse process may be removed at the same time The apex of the pleura is held upward by adhesions and fascial bands connecting it with the great vessels and nerves which traverse the subclavicular space These bands are divided Furthermore, the scalenus muscles, having their insertion into the periosteum of the first and second ribs, are likewise divided Following these two steps the apex of the pleural together with the endothoracic fascia are pushed downward There may be other small fascial bands fixing the endothoracic fascia to the upper part of the posterior mediastinum These bands are divided between ligatures because not infrequently small blood vessels accompany them If sufficient collapse is not obtained by this procedure alone the intercostal vessels and nerves are doubly ligated posteriorly and divided along with the periosteum of the rib allowing further collapse to take place As the operation is continued the endothoracic fascia together with the pleural beneath it is brought downward by blunt dissection In a recent case a roentgenogram following the first step of the operation showed the apex of the lung and pleural space to be at the level of the fourth rib The rationale of this procedure is easily understood, namely, we have not only compressed our cavity from the side but also from the top and we have permitted the normal elasticity of the lung to exert its force causing contraction of the lung from each side and hence closure of the cavity

Semb's results following this type of operation are so much better than any previously obtained that there is no question of the fact that his method will be adopted by all surgeons interested in thoracic diseases, especially pulmonary tuberculosis As a matter of fact, in the larger clinics this method is already in vogue Due to the fact that our own tuberculosis hospital has been in the process of rebuilding for a year, necessarily, the number of patients that we could treat has been relatively small The conclusion reached after a study of those upon whom we have operated by this procedure forces us to also decide that this is the best method of thoracoplasty so far employed

Why we did not appreciate this fact some years ago is probably entirely our own fault We had employed plombage in the treatment of quite a few

apical cavities In every case we had opened the thorax through an anterior approach, had stripped down the endothoracic fascia relatively easily and filled the resulting space with a paraffin-bismuth mixture This procedure brought down the pleura and endothoracic fascia and allowed the normal elasticity of the lung to close the cavity I think we could have dispensed with the paraffin, *etc* Furthermore, I am convinced that in a number of thoracoplasties good results were due to a similar procedure performed through a posterior approach In other words, that we did bring down the endothoracic fascia and pleura as we now do but did not realize what we had actually done, and, therefore, could not understand why we got results in certain cases and not in others The cases in which we did not get results were those that did not strip easily, and possibly we did not even try to push the apex of the lung down It remained for Semb to realize what was being accomplished and so develop the method now used in thoracoplasties in most clinics

In our experience this operation is not applicable to every patient We have seen a number where the adhesions between the endothoracic fascia and the great vessels which cross the apex of the pleura are so dense that it is impossible to bring the lung apex downward While it is true that this percentage is not great, nevertheless it occurs sufficiently often that this method is not universally applicable In such cases we believe that the first and second ribs should be disarticulated from the transverse processes and taken out practically in their entirety and that as much of the transverse processes be removed as is feasible Furthermore, long segments of the third and fourth ribs should be removed so that the necessity of an anterolateral rib resection may be eliminated

SUMMARY —The procedure as advocated by Semb is an adequate means of obtaining apical collapse, and is based on physiologic grounds Furthermore, this method must be combined with the removal of a sufficient length of rib to effect complete closure of the cavity We can see no reason why such a procedure could not be applied to bilateral apical cavities as long as only the first and second and one-half of the third ribs need be removed

REFERENCE

[1] Semb, Carl Thoracoplasty with Extra Fascial Apicolysis Acta Chir Scandinav, **76**, 1–85, 1935

LUNG ABSCESS

AN ANALYSIS OF THE CAUSES OF DEATH IN ONE HUNDRED CONSECUTIVE FATAL CASES

JAMES DAVIDSON RIVES, B S , M D , ROBERT CARLISLE MAJOR, B A , M D

AND

SAMUEL ANDREW ROMANO, B S M D

NEW ORLEANS, LA

FROM THE DEPARTMENT OF SURGERY OF THE SCHOOL OF MEDICINE OF LOUISIANA STATE UNIVERSITY, AND FROM CHARITY HOSPITAL OF LOUISIANA AND TOURO INFIRMARY IN NEW ORLEANS LA

THE mortality of lung abscess has not diminished appreciably in the last 20 years, in spite of marked improvement in the technic of its treatment and an even more marked improvement in our knowledge of its etiology Allen and Blackman's[2] collected statistics show a mortality of 34 3 per cent in 2,114 cases, and the actual situation is probably worse than those figures indicate, for they were collected from the best medical centers in the country Numerous writers have compared results on the basis of the therapeutic methods employed, and several individual authors have shown remarkably low death rates for their favorite procedures But these reports do not compare parallel series of cases, and they therefore leave much to be desired in explaining the causes of failure

To supply that deficiency we have undertaken an analysis of the causes of death in 100 consecutive fatal cases of nontuberculous lung abscess, exclusive of any due to tumors, foreign bodies or bronchiectasis These cases were collected from the records of Charity Hospital, New Orleans, La , in the period from 1929 to 1936, inclusive, and from the Touro Infirmary in the period from 1926 to 1936, inclusive The Touro cases have previously been reported by us [35a] In order to bring out certain facts that seemed important, it was necessary to review, less completely, the 139 cases which occurred in these two institutions in the time covered by our study The Touro group of 60 cases has been completely followed-up, but in the Charity Hospital group of 179 cases follow-up was for various reasons impractical and only the hospital mortality is presented

Age Incidence —Table I shows the frequency by decades in the entire group of 239 cases It will be noted that the mortality is higher before ten and after 40 years of age

Sex Distribution —The sex frequency of 174 males and 65 females corresponds very well with that usually reported

Race Distribution —The 60 patients from Touro Infirmary were all white Of the 179 at Charity Hospital, 111 were white and 68 colored, a somewhat higher incidence in the white race than would be expected, since the white and Negro admissions at that institution are approximately equal It is interesting

to note that the hospital mortality in the colored race was 50 per cent, as compared with 37 per cent in the white race, though studies of other conditions from this institution might have led us to anticipate such findings

TABLE I

MORTALITY BY DECADES IN 239 CASES OF LUNG ABSCESS

Decade	No of Cases	Mortality	Percentage
Under 10 yrs	23	12 deaths	52
Under 20 yrs	27	7	26
Under 30 yrs	48	12	25
Under 40 yrs	58	25	43
Under 50 yrs	37	19	51
Under 60 yrs	25	14	56
Over 59 yrs	18	11	61
Not stated	3	0	00

Mortality—The known mortality in this series is 42 per cent This is higher than the collected mortality of Allen and Blackman,[2] 34 3 per cent, and would undoubtedly be still higher if all cases had been followed to their conclusion We feel, however, that it represents, quite accurately, a cross section of results in the country as a whole

Comparison of Medical and Surgical Treatment—One hundred ninety-six of these cases were treated conservatively with a mortality of 44 per cent, and 43 were treated surgically with a mortality of 33 per cent The superficial comparison, however, is very misleading As we shall point out later, several other factors seem to have influenced results far more than has the type of treatment

TABLE II

MORTALITY IN RELATION TO ETIOLOGY

Etiologic Factors	No of Cases	Mortality	Percentage
After operations on mouth, nose and throat	43	9 deaths	21
After other operations	14	9	64
Due to septic emboli	7	7	100
Due to other causes	175	75	43
Totals	239	100	41 6

Etiology—Table II shows the mortality according to etiology It should be said that the group listed as due to "other causes" includes all the cases which followed pneumonia and influenza, as well as those cases for which no cause could be assigned Such a classification is perhaps open to criticism, but we adopted it because of the obvious impossibility of determining the character of the preceding illness, which might have been pneumonia or influenza but which might as reasonably have been primarily the same process as resulted in the abscess

The low incidence of postoperative abscesses in this group is noteworthy Other statistics show that such abscesses usually account for 40 to 50 per cent of all cases, and that 60 per cent of this group follows operations on the nose,

mouth and throat Perhaps the high mortality in our series is due, at least partially, to the small number of such relatively mild cases At any rate, the high death rate in the second and third groups suggests that abscesses due to infarcts are far more dangerous than any other type

TABLE III

MORTALITY ACCORDING TO EXTENT OF LUNG INVOLVEMENT

Degree of Involvement	No of Cases	Mortality	Percentage
Single abscesses	158	45 deaths	28 5
Multiple abscesses in single lobe	28	16	57 0
Abscesses in multiple lobes of one lung	22	10	45 5
Bilateral abscesses	31	29	93 5

Extent of Lung Involvement—Table III shows the important influence exerted on the mortality by the extent of lung involvement No other factor exerts a comparable influence on the death rate, and its influence becomes even more striking when we consider the frequency of the spread of the pneumonitis to the opposite side without abscess formation, as happened in 15 of the fatal cases in this series Any comparison of results which does not take this factor into consideration will give misleading conclusions A group of single abscesses such as Neuhof reports, or a group of "localized" abscesses such as Cutler and Gross[9] report, cannot properly be compared with this series, or with that of Bird,[4] which shows a similar variation in the extent of the lesion

Table III also demonstrates another fact to which we shall return repeatedly, the very serious consequences of the spread of pneumonitis beyond the circumscribed area of the abscess In some instances, no doubt, the lesion is widespread from the beginning, but in the majority of cases this is not true and its extent is probably due to the spread of the pneumonitis

Analysis of the Causes of Death—When we turned our attention particularly to the causes of death in this group, we had expected that three factors would be of paramount importance The duration of the disease before treatment, the extent and severity of the infection, and the methods of treatment employed Actually the results of our analysis were rather at variance with our preconceived notions

TABLE IV

DURATION OF ILLNESS BEFORE TREATMENT IN 88 FATAL CASES

Duration	No of Cases	Percentage
Under 1 month	50	57
1 to 2 mos	13	15
2 to 3 mos	8	9
3 to 6 mos	9	10
Over 6 mos	8	9

Duration Before Treatment—It seems to be almost universally agreed that prolonged neglect before treatment is instituted is a major cause of death in lung abscess Table IV shows that in this series, at least, exactly the opposite situation exists

It will be noted that in the 88 fatal cases in which the duration of illness could be accurately determined, the infection was of more than one month's duration in only 43 per cent, and of more than three months' duration in only 19 per cent, only 9 per cent of the cases could be considered very old or chronic abscesses It might be suggested that such a high mortality for early cases must be the result of very unwise management The reply to that suggestion is that 37 of these 88 cases (Table V) were in such bad condition that we have classified them as hopeless, and that in this group only 27 per cent of the cases were of more than one month's duration, only 13 5 per cent of more than three months' duration, and only 8 per cent old cases The obvious conclusion is that if one wishes to avoid a high mortality in lung abscess, one should avoid treating early, severe infections

TABLE V

DURATION OF ILLNESS BEFORE TREATMENT IN 37 HOPELESS CASES

Duration	No of Cases	Percentage
Under 1 month	27	73 0
1 to 2 mos	2	5 5
2 to 3 mos	3	8 0
3 to 6 mos	2	5 5
Over 6 mos	3	8 0

Pathology—Regardless of etiology, bacteriology or duration, the pathology of these lung abscesses, as revealed by 59 autopsy protocols and supplemented by roentgenologic and operative findings, was strikingly consistent It was a destructive pneumonitis with cavity formation The area of consolidation always exceeded the extent of the cavity during the acute stage and usually until the cavity had disappeared As a rule, more than one cavity was found at autopsy, whether or not the multiple character of the pathology had been recognized antemortem, and many of the abscesses were deeply situated in the lungs The clinical course of the illness paralleled the extent of the pneumonitis rather than the size or character of the abscess

The histologic changes revealed by postmortem were those of acute and chronic inflammation with varying degrees of necrosis In old abscesses fibrosis was usually apparent but seldom extensive Furthermore, the wall of the abscess, which grossly was frequently described as fibrous, was usually found on histologic study to be made up chiefly of fibrin and necrotic tissue Bronchiectasis, contrary to the common belief, was seldom noted at autopsy in old chronic cases, and this finding was supported by numerous bronchographies For these reasons, we conclude that very old abscesses may heal in many cases with minimal lung damage, and this conclusion has been verified by our roentgenologic observation of cured cases

It is scarcely necessary to add that in addition to the lung involvement already described and the complications to be enumerated later, all the autopsied cases exhibited the toxic changes in the liver and kidneys which are usually associated with severe acute infections

One group of cases worthy of special mention consisted of nine children all under five years of age who were admitted with a diagnosis of bilateral pneumonia and died with the same diagnosis, all but one within three weeks of the onset of symptoms At autopsy all were found to have what might be called carbuncle of both lungs, really multiple miliary abscesses throughout both lungs with extensive areas of consolidation

Bacteriology—Bacteriologic examinations were not sufficiently complete to warrant positive conclusions Spirilla and fusiform bacilli were frequently found, but the failure of arsenicals in therapy leads us to agree with those who suggest that they are often contaminators or secondary invaders rather than causative agents Anaerobic cultures were rarely made

Pathologic Causes of Death—Most of these patients died of a spreading pneumonitis, which usually, we suspect, was due to spill from the abscess into uninvolved areas By far the most important complication was empyema, usually a pyopneumothorax, which occurred in 17 of the 77 cases with infection limited to the lungs and pleura, as well as in some four other complicated cases Complications beyond the pleural cavity, as Table VI shows, were present in only 23 of the 100 cases

TABLE VI

PATHOLOGIC CAUSES OF DEATH IN 100 FATAL CASES

Causes of Death		No of Cases
Pulmonary involvement only		60
Pulmonary and pleural involvement		17
Extrapleural complications		23
Pericarditis	4 cases	
Brain abscess	3	
Pyemia	3	
Drowning	3	
Hemorrhage	2	
Pleural shock	1	
Massive atelectasis	1	
Concurrent disease	2	
Undetermined	4	

It is significant that even in this group of 23 cases, the spreading pneumonitis seems to have been the chief cause of death in 12 cases, leaving only 11 cases in the whole series in which extrapleural complications were the chief cause of death These complications include purulent pericarditis, brain abscess, gross hemorrhage and pyemia

Therapeutic Causes of Death—It is obvious that in any case the type of therapy employed must be determined chiefly by the severity, extent and location of the lesion For example, surgery is clearly impossible when all lobes of both lungs are involved, just as it is impractical in abscesses deeply situated and comparatively inaccessible to surgical approach Our conclusions as to therapy are, of course, purely matters of personal opinion, but we think that they are essentially fair and accurate In order to arrive at them we have

carefully reviewed each individual record and on the basis of our joint study have attempted to determine whether or not treatment was at fault, and if it were at fault, in what respect

Frankly Hopeless Cases—Forty-six cases are classified as having been beyond hope of successful treatment on admission This group includes all patients who were admitted moribund or who followed such a rapid downhill course that nothing more than supportive treatment was practicable It is a very large group, it is true, but the cases included in it undoubtedly belong there In 32 cases there was a bilateral spreading pneumonitis, complicated in four instances by empyema, in six by organic diseases such as diabetes or advanced cardiac disease, and in two by pyemia, in which the lung condition seemed merely an incident In 14 cases the lung involvement was unilateral, but there were also present such complications as pyemia, brain abscess and empyema It should be noted that 45 of these 46 hopeless cases were treated by conservative measures and account for the comparatively high mortality in the medical group to which we have already called attention

Cases Not Hopeless—Medical—Of the 53 cases not considered hopeless, 40 were treated conservatively, but only eight of these, in our opinion, received adequate treatment Several outstanding deficiencies were noted, more than one of which was operative in many instances, but in only 13 cases do we feel that surgery was definitely indicated, and even in some of these we feel that it might have been avoided by more thorough medical management The most important deficiencies in medical management may be listed as

(1) The almost universal neglect of transfusion

(2) The almost equally frequent neglect of bronchoscopy

(3) Delay in the institution of proper therapeutic measures

(4) Failure to carry through to its conclusion treatment which was apparently producing successful results

(5) The ill-advised use of the aspirating needle or pneumothorax Such methods resulted in empyema in seven cases, two of which ended in the surgical group

(6) Poorly planned or carelessly executed postural drainage

Cases Not Hopeless—Surgical—Thirteen patients not considered hopelessly ill were treated surgically In five of these, two of whom had only a thoracotomy for empyema caused by the use of the aspirating needle, death seemed to have occurred because surgery was delayed In four other cases the use of extrapleural compression in incompletely drained abscesses resulted in spillage to uninvolved areas and a consequent spreading pneumonitis Other causes of death included a spreading pneumonitis after surgical drainage, postoperative empyema, and repeated postoperative hemorrhage, for which, for some reason, transfusion was not employed

Certain facts difficult to reduce to figures have been apparent from our study of these records

(1) Since some degree of anemia, to be explained by the almost constant presence of blood-tinged sputum, was noted in most of these cases, it would

seem that repeated transfusions should be routine in the treatment of lung abscess, not only to correct the anemia but for their supportive effect

(2) If an acute spreading pneumonitis is present, supportive treatment alone is practical Surgery, bronchoscopy, or even postural drainage is likely to cause spillage and aggravate the pulmonary condition, and cardiac failure is another possible consequence

(3) Whether or not Spirilla were found in the sputum, the records show no real evidence of specific benefit following the use of neosalvarsan and bismuth They were used almost routinely, but their effectiveness, if it was evident at all, seemed entirely incidental to other methods of treatment being employed simultaneously

(4) Postural drainage must be carefully planned and even more carefully supervised to be effective Sudden evacuation of an abscess is likely to spread the infection into uninvolved areas, and was responsible in this series for three deaths from drowning The drainage, therefore, should be as nearly constant as possible

(5) Bronchoscopy is an exceedingly valuable diagnostic and therapeutic procedure It determines the cause and location of the abscess, and it aids in opening and keeping open the bronchial passages On the other hand, it cannot be used with safety more than two or three times a week, and no abscess can be cured by this method of treatment alone, though it is an auxiliary procedure which should be used in conjunction with other methods when postural drainage is not effective or when the diagnosis is doubtful

(6) The instillation of lipiodol into the lung was employed many times in this group of cases for both diagnostic and therapeutic purposes On only one occasion did subsequent radiography show the opaque substance in the abscess cavity This suggests to us that while the procedure is probably of no therapeutic value, it may be useful in differentiating true from bronchiectatic abscesses

(7) Aspiration of a lung abscess is a useless and dangerous procedure, which is indefensible from any standpoint

(8) Although artificial pneumothorax was attempted in a number of cases, there is no evidence that it was of value in any, and quite definite evidence of its dangers, in four cases a fatal empyema developed after it was used Furthermore, in no single instance was the involved portion of the lung fully collapsed, although in many instances the uninvolved portion was It is true that some centrally located abscesses may respond to pneumothorax, but we personally believe that the method is dangerous out of all proportion to its usefulness As King and Lord[24] have remarked, there is no parallel between the treatment of tuberculous cavities, in which the purpose of therapy is to secure rest, and lung abscesses, in which the purpose of therapy is drainage

(9) Phrenic nerve paralysis was infrequently used, and never with impressive results

(10) We do not believe, from our analysis of these cases, that there is any basis for the statement so frequently made by surgeons, that if all lung abscesses

were treated surgically, the mortality of the disease would be lower Unless they qualify their statement, and limit it to single abscesses after the acute stage is past, we believe that they are badly mistaken In this series, for instance, many patients had such widespread disease that multiple operations would have been necessary Other patients had such deeply situated abscesses that for all practical purposes they were inaccessible Every time surgical drainage was used it was followed by a spread of the pneumonitis, and sometimes new cavities appeared which in acute cases might be sufficient to cause death Finally, deep-seated abscesses, when opened externally, never drained satisfactorily It is only fair to say, on the other hand, that in five cases surgical drainage seems to have been established too late, and that in 13 cases treated conservatively surgical drainage seemed indicated and was not done

(11) In at least 13 cases in the entire series, nine of which terminated fatally, spontaneous pyopneumothorax occurred These abscesses must have been superficial and should have been drained surgically before empyema occurred

CONCLUSIONS

Three more or less controllable factors contributed, in an important degree, to the mortality in this series They are, in the reverse order of their importance, anemia, empyema, and spreading pneumonitis Anemia may be readily controlled by transfusion and by adequate supportive treatment Empyema may be avoided in most instances if surgical treatment is instituted early in superficial lesions and if needling of the chest is entirely abandoned Spreading pneumonitis, the chief cause of death, may be minimized if we avoid attempts to drain the abscess cavity during the acute stage, if we avoid compression therapy, especially when the cavity is incompletely drained, if we avoid all measures such as intermittent postural drainage likely to cause severe paroxysms of coughing while the cavity is full, and if we avoid surgical drainage in the acute stage and at any time at all in deep seated abscesses

Approximately half of the deaths in this series were probably not preventable by any method of treatment at present available, but we may fairly say that in many of the remaining fatal cases the fatality might have been avoided by adequate supportive treatment combined with the judicious use of commonplace methods of bronchial or external surgical drainage Certain courses of action, however, should positively not be employed Thus, prolonged inadequate treatment invites extrapleural complications Prolonged conservative treatment of superficial abscesses invites empyema, as does also needling of the chest Premature efforts to drain the abscess by either radical or conservative measures, compression therapy employed on incompletely drained cavities, surgical drainage of deeply seated abscesses, and purely intermittent postural drainage all invite the deadly spreading pneumonitis which was the cause of death in four-fifths of our fatal cases

The best results will be attained by an orderly plan of treatment which utilizes supportive measures, bronchial drainage and surgical drainage accord-

ing to their proper indications, and as they are suited to the individual case, and which is continued until the abscess has completely disappeared

REFERENCES

[1] Allen, D S Etiology of Abscess of Lung, Experimental and Clinical Studies Arch Surg, 16, 179, 1928
[2] Allen, C I, and Blackman, J F Treatment of Lung Abscess, with Report of 100 Consecutive Cases Jour Thor Surg, 6, 156, 1936
[3] Bethea, O W The Treatment of Pulmonary Abscess Internat Med Digest, 26, 114, 1935
[4] Bird, C E The Treatment of Large Pulmonary Abscesses J A M A, 107, 1288–1292, October, 1936
[5] Brunn, H Lung Abscess J A M A, 103, 1999–2003, December, 1934
[6] Buschmann, T W Surgical Treatment of Lung Abscess Northwest Med, 25, 297, December, 1925
[7] Cole, W H, and Elman, R Textbook of General Surgery, D Appleton-Century Co, New York and London, 1936
[8] Christopher, F Textbook of Surgery, W B Saunders Co, Philadelphia and London, 1936
[9] Cutler, E C, and Gross, R E Nontuberculous Abscess of the Lung Jour Thorac Surg, 6, 125, December, 1936
[10] Cutler, E C, and Schlueter, S A The Experimental Production of Lung Abscess Annals of Surgery, 81, 256–270, January, 1925
[11] Edwards, A T Surgical Technic of Pulmonary Abscess Brit Jour Surg, 17, 102, July, 1929
[12] Flick, J D, Clerk, L H, Funk, E H, and Farrell, J T Pulmonary Abscess, Analysis 172 Cases Arch Surg, 19, 1292, 1929
[13] Graham, E A Treatment of Pulmonary Suppuration Annals of Surgery, 86, 174, August, 1927
[14] Graham, E A Treatment of Abscess of the Lung Ann Clin Med, 4, 926, May, 1926
[15] Graham, E A, Singer, J J, and Ballon, H C Surgical Diseases of the Chest Lea and Febiger, Philadelphia, 1935
[16] Harrington, S W Surgical Treatment of Pulmonary Suppuration J A M A, 87, 1200, October, 1926
[17] Hedblom, C A Abscess of Lung with Special Reference to Treatment Minn Med, 2, 337, September, 1919
[18] Hedblom, C A Pulmonary Abscess Lewis' System of Surgery W F Prior Co, Hagerstown, 5 (chap 2), 1930
[19] Heuer, C J Etiology and Treatment of Pulmonary Abscess Surg, Gynec, and Obstet, 52, 394, February, 1931
[20] Holman, E Etiology of Postoperative Pulmonary Abscess Annals of Surgery, 83, 240, February, 1926
[21] Holman, E, Chandler, L R, and Cooley, C L Experimental Studies in Pulmonary Suppuration Surg, Gynec, and Obstet, 44, 328–339, March, 1927
[22] Iglauer, S Aspiration of Blood into Larynx and Trachea during Tonsillectomy under Local Anesthesia A Contribution to the Etiology of Lung Abscess Ann Otol, Rhinol, and Laryngol, 37, 231, March, 1928
[23] Kernan, J D Abscess of Lung Relieved by Bronchoscopy, Report of Cases Arch Surg, 16, 215, January, 1928
[24] King, D S, and Lord, F F Certain Aspects of Pulmonary Abscess from Analysis 210 Cases Ann Int Med, 8, 468, October, 1934

[27] Kline, B S, and Berger, S S Abscess and Gangrene of Lung Clinical Course and Pathology Arch Surg, 18, 481–489, January 7, 1929
[28] Kline, B S, and Berger, S S Spirochetal Pulmonary Gangrene Treated with Arsphenamines J A M A, 85, 1453–1458, November, 1925
[27] Kline, B S, and Berger, S S Pulmonary Abscess and Pulmonary Gangrene Arch Int Med, 56, 753, October, 1935
[29] Lemon, W S Abscess of Lung Canad Med Assn Jour, 10, 1079, December, 1920
[29] Leon-Kindberg, M, and Soulas, A Le traitment des abces du poumon Presse Med, 38, 1591, November, 1930
[30] Lilienthal, H Nontuberculous Pulmonary Suppuration, Comparison Operations and Their Results Arch Surg, 16, 206, January, 1928
[31] Lockwood, A L Abscess of Lung Surg, Gynec, and Obstet, 35, 461, October, 1922
[32] Maes, U Spirochetal Pulmonary Gangrene Internat Clin, 2, 197, 1926
[33] Middeldorpf, K Dur Behandlung der Lungenabszesse Deutsche Ztschr f Chir, 206, 314, 1927
[34] Nelson's Loose Leaf Living Surgery, V 4 Thomas Nelson and Sons, New York and London, 1927
[35] Pinchin, A J S, and Morlock, V H Bronchoscope in Treatment of Pulmonary Suppuration Lancet, 2, 605, September 17, 1932
[36] Rives, J D, Major, R C, Romano, S W Non-tuberculous Lung Abscess New Orleans M and S J, 90, 410, January, 1938
[37] Sergent, E, and Iselin, M Abscess of Lung with Pleural Effusion Jour Thor Surg, 3, 109, December, 1933
[38] Singer, J J, and Graham, E A Treatment of Bilateral Lung Suppuration Am Rev Tuberculosis, 13, 225, March, 1926
[39] Singer, J J, and Graham, E A Bronchography, Clinic Demonstration Arch Surg, 19, 1552, December, 1929
[40] Smith, D T Experimental Aspiratory Abscess Arch Surg, 14, 231–238, January, 1927
[41] Touroff, A S W, and Moolten, S E The Symptomatology of Putrid Abscess of the Lung Jour Thoracic Surg, 4, 558, August, 1935
[42] Van Allen, C M, Adams, W E, and Hrdina, L S Bronchogenic Contamination in Embolic Abscess of the Lungs Arch Surg, 19, 1262–1278, December, 1929
[43] Wood, Cornelius Pyopneumothorax Occurring as a Complication of Acute Pulmonary Suppuration Am Jour Surg, 30, 289–297, November, 1935

DISCUSSION OF THE PAPERS OF DOCTORS FRANK, WILLIS AND RIVES

DR JAMES M MASON (Birmingham, Ala.)—Doctor Willis and I have been in friendly disagreement for some time concerning the methods of procedure in the treatment of empyema in children, and he kindly sent me his paper to read previous to this meeting I have on other occasions paid tribute to his skill as a general surgeon, and referred to the fact that his mortality rate on a large series of gunshot wounds of the abdomen is the lowest on record The same may be said of his present paper He has shown the lowest mortality rate yet recorded in the "punch" operation for empyema in children, 104 cases with a mortality rate of 4 8 per cent This is a remarkable accomplishment

Of the greatest interest is the progressive reduction in the mortality of empyema in children which has been recorded in the past few years I attribute this to the more careful study of the disease, to the publications of large series of cases, and to discussion of different points which affect morbidity and mortality A low death rate demands the personal interest and

continuous care of the intelligent surgeon who follows his cases to full recovery The series presented by Doctor Willis received this personal care Collected series from different hospitals treated by numerous surgeons may be expected to show a somewhat higher mortality Morbidity, likewise, is influenced by the same factors I am not alone in the belief, however, that morbidity and mortality may be considerably influenced by the efficacy of the method of drainage which is employed

While chronic empyema frequently occurs in adults, it is practically nonexistent in children, so I think that we may exclude all references to it in this discussion In properly executed rib resections osteomyelitis is rarely encountered I have never seen a case in a child

Several references are made to the too early open operation, notably in the author's quotations from Fitzgerald, in which all the unfortunate sequelae mentioned may take place "if operation is employed too early in the course of acute, total empyema', and again, in the author's own words, "a rib resection, certainly in the synpneumonic stage is, in my opinion, dangerous surgery and often the cause of fatality" Nothing has been more definitely established in thoracic surgery than that no open operation should be performed in the synpneumonic stage of empyema, and such operations are not now practiced

One of the important objections which has been raised to the "punch" operation is that, through accident or otherwise, the pleural cavity may not remain closed, thereby converting an early closure into an early open operation with disastrous results This was put forward by the Empyema Commission of the United States Army as one of the reasons why this method of treatment was not adopted for Army hospitals during the World War

The author admits that those in charge of the after-treatment of cases treated by the "punch" operation must be thoroughly trained in all the maneuvers necessary to get rid of fibrinous flakes, through small tubes, and that there is no question but that it is more difficult to treat these patients by this method than by placing a large tube in the chest through an opening made by resecting a rib He claims, however, that lowered mortality, freedom from postural changes, unsightly scar, and pus-soaked dressings, should compensate these patients and the surgeon

In defense of rib resection, I shall plead guilty to only one of these charges, namely, the production of a scar Surgeons must leave their trade mark, even though it be unsightly at times In rib resection, with free and complete evacuation of the empyema cavity, pus-soaked dressings are conspicuous by their absence after the first three or four days In any event, the dressings can be changed so simply and so quickly that there is no material loss of time in making the change as often as the amount of drainage may demand it, and it can be done by anyone with ordinary training in surgical dressings It does not require the specially trained or skilled personnel to go through the tedious and careful manipulations necessary, unstop plugged tubes and irrigate cavities which have been ineffectually drained through tubes of small caliber

In 1935, at the meeting of the American Medical Association, I presented a series of 103 cases of empyema in children, from the Hillman Hospital and from the Children's Hospital, which had been treated by myself and other members of the staffs The mortality rate was 7 76 per cent A few years ago, Dr James Bodley, of Memphis, reported in the Southern Surgeon a series of 100 consecutive cases of empyema in children treated by repeated aspiration followed by rib resection, with only one death

Of the 103 cases reported in my paper, above referred to, 40 were under my personal care and were operated upon and followed to complete recovery by me In this group there was only one death, a mortality rate of 2 5 per

cent Since that report I have operated upon 21 additional cases without a fatality, a mortality rate of 1 64 per cent for 61 cases

In our series, the empyema cavity was completely obliterated in an average of 32 days, in the author s series obliteration required 52 5 days

From these statistics, both of morbidity and mortality, the odds seems definitely to favor rib resection and free drainage

The paper of Doctor Rives on lung abscess is very interesting Patients who suffer from this disease are extremely ill and show the effects of the violent sepsis which is usually present before drainage of the abscess has been accomplished

Drainage may be established in several ways Rupture into a large bronchus with expectoration of the pus results in some spontaneous recoveries This process is much assisted by postural drainage Aspiration through the bronchoscope has resulted in many cures External drainage in one or two stages has often to be resorted to

It is interesting to observe the development and recession of a lung abscess as revealed by roentgenograms In five patients who have recently been treated in our clinic, these abscesses were complications of the following conditions Gunshot wound of the chest, 1, tonsillectomy, 1, abdominal operations, 2, acute respiratory infection, 1

One patient refused operation and has been lost sight of Two recovered spontaneously after free expectoration assisted by postural drainage One recovered after a two-stage operation for external drainage In one case, after bronchoscopic aspiration had failed to relieve, the abscess ruptured into the pleural cavity, converting the case into one of pyopneumothorax This was relieved by rib resection and tube drainage of the empyema cavity

DR ALBERT O SINGLETON (Galveston, Texas) —Doctor Frank spoke of the advantage, at times, of removing the angle of the scapula rather than sacrificing more ribs I think Doctor Holman of San Francisco has published a paper on this procedure We have found that a tremendous amount of collapse will occur in the upper portion of the lung if the angle is removed The weight of the scapula with the mass of muscles attached to it swings down with excellent effect So long as the angle is present and resting upon the underlying ribs it prevents a satisfactory collapse

I am particularly interested in empyema drainage At one of our meetings some ten years ago, Doctor Mason and I read papers upon this subject He seems to be very insistent about rib resection, even though I thought I had convinced him at that time that it is not the thing to do As has frequently been said, "good surgery depends upon attention to details," and if one has a good procedure and is satisfied with it, it is probably a mistake for him to change About 15 years ago we discarded rib resection and started using a metal tube between the ribs, and think it has advantages over the rib resection

TABLE I

Age Group	Recovered	Died	Total	Mortality Percentage
Under 5 yrs of age	23	2	25	8
5 to 20 yrs of age	52	1	53	2
(Children under 20 yrs of age)				4
20 to 40 yrs of age	42	2	44	4 5
Over 40 yrs of age	21	7	28	25
	138	12	150	8

If adequate drainage is secured I see no reason to remove the rib We select the space just below the angle of the scapula The tube is passed between the ribs, the trocar removed and the cannula which remains in place is connected by a rubber tube to a bottle of water We obtain a closed drainage which lasts for about two weeks The metal tube is then removed and a rubber tube substituted for it We believe irrigation is contraindicated We have treated with this tube, and without rib resection, 150 consecutive cases (Table I) Two of these (adults) became chronic, necessitating secondary operation with decortication of the lung before they healed

A high mortality comes not from the empyema in a majority of these cases but from some associated disease Five of these deaths were cases with cardiac disease I think the empyema problem is quite well understood generally now and the results are good The selection of the proper time for drainage is of great importance

DR M J HENRY (Louisville, Ky) —Certainly Doctor Willis is to be congratulated upon his low mortality Recently I reviewed some of the literature on empyema and find that the majority of men reporting their cases had a mortality around 10 per cent In a recent study of the histories of the last 70 cases of empyema in our files, most of which were operated upon by Dr Irvin Abell, Sr , and a few by myself I found that there were seven deaths, a mortality of 10 per cent There was one death of a child, age 4, who also had pulmonary abscesses Another child had a severe intestinal infection and death was due to that condition One had a low-grade Streptococcic infection, another a lobar pneumonia, and there was one child, age two months, who had pneumonia on the opposite side

It seems to me that in advocating any method of treating empyema surgically, one should consider not only the mortality but also the ability of the average surgeon to carry out the proposed plan Since the average surgeon can take care of the case that is treated by rib resection, I think it should be his choice If one looks upon empyema not as an emergency procedure, and if he avoids performing an open operation on those who have seropurulent exudate, or pulmonary disease in the opposite side, his results should equal the mortality rate, presented today, and in addition the open operation would require no special training to carry it out

DR JOSEPH E J KING (New York, N Y) —In 1918, and part of 1919, I was associated with Drs Frederic Kammerer and Alexis Moschcowitz at the Army General Hospital No 12, at Biltmore, N C The patients in this hospital for the most part had empyema, mostly chronic cases, but there were a few cases of acute empyema

In the cases of chronic empyema there were many which failed to heal In some the tubes had been lost in the cavity, gauze drains in the cavity, the necrotic end of the rib had been pushed off by drainage tubes and fallen into the cavity, the incision had been placed too low so that a long sinus formed with the elevation of the diaphragm, bronchial fistulae, *etc* No children were included among these cases They were soldiers, therefore young adults, and most of them were quite emaciated Some of the patients had only a persistent sinus due, for the most part, to a bony ring having formed around the drainage tract site between the ends of the resected rib, only a short piece of rib having been removed In a number of these patients this bony ring was attached to the rib and below, so that three ribs were fused and required resection of all three ribs in order to permit the sinus to heal

It was also observed that the bony ring had formed around the drainage

sinus in cases in which an intercostal drain had been inserted without resection of rib In other cases in which a cavity persisted, the shape of the cavity was demonstrated roentgenologically after injection of thorium nitrate These cavities usually had one of three shapes One was the long feather-shaped cavity which ran posteriorly alongside the vertebral column anterior to the costovertebral angles Another was the shape of a palmetto fan, flattened from before backward on the posterior external surface of the lung, with the sinus extending downward over and posterior to the diaphragm The third form was somewhat irregular and extended anteriorly from the sinus

In order to obliterate these cavities we had to resort to resection of several ribs overlying the cavity, and sometimes decortication of the lung It is remarkable how well these patients, upon whom a rather extensive thoracoplasty had been performed, did, when the operation followed prolonged dakinization of the cavity, as compared with the results obtained by the older Schode and Eslander operations in the presence of gross infection

In order to prevent this prolonged chronicity in cases of empyema it was the consensus of opinion of the men who worked in this empyema hospital that the best operation for empyema in cases of acute empyema in adults was rib resection with removal of a goodly portion of rib, three inches or so It was also deemed advisable that the incision should not be made too low posteriorly in order to prevent formation of a long sinus

This conclusion was reached after observation had been made on patients operated upon by both methods, resection of rib, and intercostal drainage I, therefore, agree heartily with what Doctor Mason has said

Dr Deryl Hart (Durham, N C) —It seems to me that the most important factor in the treatment of empyema is to know the underlying pathologic condition and the physiologic and anatomic disturbances which have been produced We should then have as our definite aim the cure of the pathologic condition with a restoration of the chest to the normal anatomic and physiologic state Every surgeon should know what method of treatment will, in his hands accomplish these ends most satisfactorily, and should treat his patients accordingly I prefer closed drainage with a very small amount of suction, the drainage system being filled with physiologic salt solution or, in the chronic case, with a mild, nontoxic antiseptic The amount of suction must be regulated in order to accomplish the object in view The normal respiratory movements will cause a so-called "tidal irrigation" so long as the drainage tube is patent, the cavity open, and the amount of suction not too great

Whether to resect a rib or not to resect a rib is of little significance in the average case of empyema Even the advocates of open drainage have a closed cavity as soon as the dressings become wet with secretions Such dressings will allow the pus and air to escape but prevent the free entrance of air into the cavity and thus facilitate expansion of the lung

Our first object in treatment should be to relieve pus under tension with the minimal disturbance of the physiologic or defense mechanism It is much better to have a rib resection with an open cavity and free drainage, provided there is not too great a mobility of the mediastinum, than to have a simple aspiration or a closed drainage, if all tension is not relieved and the pus is allowed to extravasate through the chest wall I have seen patients with an extravasation of pus extending over a large area of the chest and abdomen following a diagnostic aspiration of a few cubic centimeters of thin pus

It is my policy to aspirate through a needle to locate the cavity or the dependent part of a cavity, then to leave the needle in place until a tube is

inserted and all tension relieved In case a tube is not to be inserted, the aspiration is continued until the pressure in the cavity is less than atmospheric pressure Whenever there is an extravasation of pus we can be sure that the pressure within the cavity is greater than atmospheric pressure

Following relief of tension we should provide free drainage until the infection has subsided It is immaterial as to how this is accomplished, provided it gives the minimal disturbance to the physiologic and defense mechanisms In my hands this can be done most effectively by having the cavity bathed in a relatively clean physiologic salt solution, using a closed system Whenever there is leakage of pus or irrigating solution around the tube, it means that the pressure in the cavity has risen above atmospheric pressure If there is leakage of pus past the parietal pleura, the hole around the drainage tube should be sufficiently large to provide free drainage to the surface, thus preventing extravasation through the tissues

After the infection has subsided our object should be to obliterate the cavity without causing any pocketing To accomplish this we apply very gradually increasing suction with periodic release of suction and distension of the cavity After irrigation stops as a result of closure of the cavity, the tube is gradually withdrawn over a period of several days, maintaining suction during this time The average empyema can be healed by this method within from 15 to 30 days, depending on the age of the patient and the care which is given the case

The presence of a bronchial fistula, which is sometimes considered to be a serious complication, offers little difficulty if one knows how to handle it The average fistula will close within 12 to 48 hours after the application of suction To apply suction, air must be removed from the cavity faster than it can leak in through the fistula The lung is then expanded, the fistula is drawn against the parietal pleura and held there until adhesions form In my experience with acute empyema, the only bronchial fistula that could not be closed by this method was in a patient where the fistula was directly opposite the thoracotomy opening In this case we changed our objective from closure by suction to the formation of a long fistulous tract extending from the bronchus to the skin A mushroom catheter was inserted and suction maintained for ten days, after the cavity was obliterated, to allow firm adhesions to form between the parietal and visceral pleura The tube was then removed and the long fistula closed within a few days

Another example of what can be accomplished by having a definite plan of attack, and knowing what can be expected, is that of an empyema which followed a total pneumonectomy The thorax had been closed without drainage The empyema cavity was obliterated by the following measures

(1) Closed drainage was instituted well anterolaterally so as to be out of the field of an extrapleural, paravertebral thoracoplasty

(2) Suction was applied to collapse the cavity by pulling in the chest wall, elevating the diaphragm and shifting the mediastinum

(3) An extrapleural, paravertebral thoracoplasty was performed in an aseptic field, removing five and seven ribs at the first and second stages The large number of ribs were removed at each stage since it was felt that the mediastinum was somewhat fixed by the infection and no lung was to be collapsed

(4) Thirty days after the second stage of the thoracoplasty the roof of the small residual cavity was removed to allow the soft parts to fall in

These three operative procedures for obliteration of the cavity required about two months, since we allowed a month after the extrapleural thoraco-

plasty for adhesions to form before unroofing the residual cavity The patient's temperature did not go above 100° F during this entire time We account for this by the fact that for the first two operations we had free drainage of the empyema cavity, an aseptic field for the operation and sterile air in the operative region For the last operation we had a relatively small cavity which had been thoroughly cleaned with Dakin's solution and the wound was left wide open to allow free drainage The wound healed rapidly following this operation and has remained closed At no time during the two and one-half months of closed drainage before, during and following the extrapleural thoracoplasty, was there any leakage about the thoracotomy tube, demonstrating that closed drainage of the pleural cavity can be maintained without leakage

Dr Robert C Austin (Dayton, Ohio) —My remarks are prompted by enthusiasm for the Semb apicolysis procedure My experience is small—22 first stage Semb operations I believe the Semb procedure is fundamentally sound It permits closure of the cavity, and if we may believe Semb's figures, 25 per cent enhancement will occur in the figures of successful closure

There is one additional point, to which sufficient weight is not given—that is, the removal of the intercostal bundles and cartilage beds, which permits of the extension of the interval between the first and second stages, and thereby allows the patient to undergo the second procedure with much less risk

Dr George Hendon (Louisville, Ky) —I would like to propose a procedure, the chief recommendation for which is that it does not interfere with anything that has been proposed—it is purely supplementary For closing these sinuses which have been perhaps long existing, we use positive air pressure that goes through a heat unit, heating it to 160° F The air then goes through a chamber in which crystals of iodine have been deposited The heated iodine vapor is then carried into the wound cavity This sterilizes, as nearly as possible, these cavities, and causes them to close I had one case with a bronchial fistula which closed promptly under this treatment

Dr James D Rives (closing) —I should like to make one comment on Doctor Willis' paper, in confirmation of what Doctor Mason and others who discussed it have said We feel very strongly that the method of treatment of empyema is considerably less important than is the man who is using the method In other words, it is possible to secure adequate drainage and to bring down the mortality by any one of a number of methods, but every one of them calls for unremitting and intelligent care Drainage by open incision is perhaps the best plan in hospitals not equipped for other procedures, or in the hands of inexperienced surgeons

The cases exhibited by Doctor Mason also suggest a comment One patient had an abscess which improved under conservative treatment, but it is significant that at the time of the last roentgenogram the cavity was still present I am sure this patient was still under treatment, but I am using this picture to make the point that any patient who is discharged, not necessarily from the hospital but from medical attention, while a cavity still exists, is carrying around in his body the seeds of his own destruction No lung abscess is cured until the cavity is completely obliterated, until the space in which the pus has accumulated has completely disappeared We personally know of four patients in this category They left the hospital in which they had been treated and in which adequate drainage had been carried out Perhaps they refused to stay longer, perhaps the physician or surgeon had been lulled into a false sense of security Whatever the reason, they had no fur-

ther treatment—all four died, one of them after he had been at work for six months He developed what was thought to be pneumonia, and while he was being transported to the hospital he was seized with a fit of coughing, the entire contents of a large abscess were aspirated, and in a few minutes he was dead from drowning

DR BYRD C WILLIS (closing) —I would like to tell you the reason for my taking up the "punch" operation I was a very young surgeon when the World War took place and was called to the Naval Hospital at Newport, R I, in March, 1918 In the fall of 1917 they had had an epidemic of measles followed by pneumonia and empyema I found that there were at least 20 cases of chronic empyema in my ward The staff members told me about the terrible scourge they had had and the high mortality—60 per cent The patients were all treated by the Carrel-Dakin method after rib resection I had had no experience of that sort in civilian life I had performed some rib resections, and a few "punches," but after seeing all these terrible cases I decided to try the "punch" operation in preference to rib resection These cases are not to be left in the hands of anyone who is not thoroughly trained It will fail if the treatment is not carried out properly I think that Doctor Mason is right in saying that a man should use whatever method he has practiced with the lowest mortality

CARCINOMA OF THE STOMACH WITH SPECIAL REFERENCE TO TOTAL GASTRECTOMY

ARTHUR W ALLEN, M D

BOSTON, MASS

FROM THE SURGICAL DEPARTMENT OF THE MASSACHUSETTS GENERAL HOSPITAL BOSTON, MASS

BETTER diagnostic methods and advancement in surgical procedures have been associated with encouraging results in the increasing trend towards radical operation for cancer of the stomach Recognition of the probability of malignancy in any ulceration within the immediate prepyloric region brings many of these patients to the surgeon in an early and easily resectable phase of their disease [1] Improvements in preoperative preparation, anesthesia, operative technic and after-care have combined to increase the operability of many lesions previously considered hopeless The advanced state of the disease with its effect upon the general condition of the patient has not deterred the surgeon in making the attempt at resection, except in those individuals with distant metastases or with involvement of too many structures by direct extension This tendency to increase the operability percentage has been largely responsible for the maintenance of a justifiably high operative mortality Many of these patients who survive operation are free of disease five years or more, and those who die of recurrence have comfortable respites well worth the effort made upon them

In a follow-up study of patients surviving partial gastrectomy for cancer, in the Massachusetts General Hospital prior to 1926, Parsons[2] reports 20 per cent of these living from five to nine and one-half years after operation Since this report, 713 patients with carcinoma of the stomach have been admitted to this clinic Table I gives some idea of the operability in this group Exploratory celiotomy was obviated in six doubtful patients by peritoneoscopy, carried out by Doctor Benedict,[3] and in many others operation was considered feasible when this procedure failed to reveal implants in the liver or peri-

TABLE I

ADMISSIONS OF PATIENTS WITH CANCER OF THE STOMACH

Massachusetts General Hospital, 1926–1936

	Cases	Died in Hospital	Mortality Percentage
Not operated upon	254	28	11
Exploration only	165	30	18
Palliative operation	105	37	35
Subtotal gastrectomy	176	58	33
Total gastrectomy	13	6	46
Totals	713	159 (Operative mortality 28 5%)	
	770		

toneum End-result studies of all resections performed five years or more ago will shortly be reported by Parsons and Welch

We will confine ourselves in this report to a discussion of those patients subjected to total gastrectomy at the Massachusetts General Hospital, and discuss chiefly the details of surgical technic pertaining to this operation Since 1932, a total of 15 total gastrectomies have been performed Five of them are personal cases, and the remaining ten were operated upon by eight other members of the staff In addition to the 13 patients with cancer, one had a lymphoblastoma superimposed upon an old gastric ulcer for which cauterization and gastro-enterostomy had been performed several years before, and the other was thought to have cancer at the time of operation but pathologic examination of the specimen proved it to be a benign ulcer instead Eight of these patients survived operation Since discharge from the hospital, three have died, one in two months of inanition based on a psychosis existing prior to operation, one in four and one-half months, recurrence having been proved at a subsequent exploration, and the third after 12 months, probably of recurrence Two of the remaining number living at the time of this report are believed to have recurrences seven months and three years respectively, since operation Two are believed to be free of disease, one year and four and one-half years respectively, since operation The case of benign ulcer mistaken for cancer at operation was alive and well six months later but cannot be traced further The patient alive the longest time had a highly malignant adenocarcinoma with involvement of regional lymph nodes He has had a little trouble recently in taking solid food Examination fails to reveal any positive evidence of recurrence He has no anemia, is working regularly, and has maintained his weight There is at present some constriction in the lower esophagus, without disturbance of the mucosal pattern His symptoms have been considerably relieved by a revision of his diet and the administration of belladonna

In 1927, Doctor Finney[4] reported five cases of total extirpation of the stomach Three of these were his own and two had been operated upon by Doctor Rienhoff The complete discussion by these authors on historic data, definition of total gastrectomy, physiologic considerations, technical procedures, *etc*, remains a classic on the subject They pointed out that when a small section of uninvolved stomach could be left for anastomosis to the intestine, the mortality would be cut in half, but that these could not be classified as total gastrectomies They collected from the literature 67 cases that they felt were complete gastrectomies The mortality averaged approximately 50 per cent, death being due to peritonitis in 58 per cent and shock in 22 per cent Various other technical difficulties were responsible for the remaining failures

In 1933, Roeder[5] reported three cases of his own and collected all authentic total gastrectomies since Finney and Rienhoff's publication, bringing the number up to a total of 88 It is now impossible to collect the unreported cases since the operation has become quite commonplace, but doubtless it is

safe to estimate that at least twice as many have been accomplished as have been reported

These immediate and final results may seem discouraging but one cannot help pitying these unhappy patients when they are left to die of this most uncomfortable disease Nausea is almost constant and food repulsive Their minds remain clear to the end and opiates relieve them but little We are sure that any reasonable attempt to eliminate their disease and suffering is justifiable A short respite is worth while and one may always hope for a cure Six years ago, I had the unpleasant duty of watching a surgeon friend



FIG 1 —In this roentgenogram the stomach is shown lying mainly to the left of the spinal column It is long and tubular indicating an easy type for resection



FIG 2 —In this roentgenogram the stomach is shown as lying high and one can visualize a thickened invaded gastrohepatic omentum that would make extirpation more difficult

die horribly, only to find at autopsy, the entire stomach involved by the linitis plastica type of cancer with no metastatic extension or adherence to other structures He had submitted to exploration by a colleague six weeks prior to his death but had forbidden him to attempt a total gastrectomy We determined at this time to familiarize ourselves with the technic, so that if a similar occasion arose in our experience a cure might be obtained So far, however, we have not seen a patient with so favorable a lesion

Many of the steps in the operation, as it will be described, have been taken from well known operative procedures and doubtless all of them have been employed We believe details are important, as the margin of safety is narrow

Preoperative Preparation —These patients come to the hospital in varying degrees of malnutrition Water and salt balance can be reestablished, anemia combated by blood transfusions, and their livers stored with glycogen

Large doses of vitamin C should be administered daily The operative schedule must be elastic on the day of operation and the surgeon unhurried

During the roentgenologic studies it is important to obtain a direct anteroposterior view of the stomach filled with barium We have observed that if the stomach lies mainly to the left of the spinal column, possible extirpation of the organ is much more feasible (Fig 1) This is obvious when one considers how the stomach is drawn upward towards the liver and bile ducts when the gastrohepatic omentum is chiefly involved in metastatic malignancy When the stomach lies transversely and high, radical extirpation is often impossible (Fig 2) Gastroscopy and peritoneoscopy are helpful in determining the diagnosis and operability in doubtful cases The ease with which total gastrectomy can be carried out on some patients as compared to others is not wholly due to the extent of the local lesion The thin ptotic individual with a short anteroposterior diameter lends himself to this procedure much better than the heavy, barrel-chested person who makes the task very difficult

Anesthesia is important since pneumonia has played a definite rôle in our mortality Local bloc should be used while making the exploration and can be continued until the operative procedure is well along towards complete mobilization of the stomach Gas-oxygen-ether sequence or cyclopropane anesthesia is usually necessary for the later stages of the operation If one starts with a general anesthetic, it is wise to use an intratracheal insufflation apparatus with a closed machine Complete control of the patient is essential

A Levine tube should be introduced prior to operation and suction applied throughout the mobilization process This tube is withdrawn by the anesthetist to the lower end of the esophagus and suction maintained while the jejuno-esophageal anastomosis is being accomplished This is an idea of Vincent's,[6] and has, we believe, materially reduced intraperitoneal infection, since it prevents mouth secretions from contaminating the operative field After the anastomosis is accomplished, the tube is brought down into the distal limb of the jejunum This allows the passage of saliva through the stoma without contaminating the suture line We do not advise depending upon this tube for feeding since it may become accidentally dislodged

Operative Procedure—The abdomen is opened through a long, left paramedian incision which is carried to the angle between the xyphoid and the costal border The dissection is begun by severing the duodenum between clamps with the actual cautery (Fig 3) The duodenal stump is infolded with two rows of chromic No 0 catgut on atraumatic needles The greater curvature is freed first unless involvement is more extensive on this side, and care is taken to separate the middle colic vessels where they are almost invariably adherent to the posterior surface of the antrum No attempt is made to preserve the blood supply to the omentum as it is important to include much of this structure below the gastro-epiploic vessels in order to remove the nodes along the greater curvature (Fig 4) Although this leaves the remaining omentum dependent on its scanty and loose anastomotic blood supply along the transverse colon, we believe that this is less time-consuming

than detaching it from the colon and including it all in the dissection as advocated by Ogilvie [7] After most of the greater curvature is freed, the stomach can be drawn downward in such a manner that the vessels and nodes along the lesser curvature can be more readily secured (Fig 5)

The left lobe of the liver is then detached from the diaphragm, after the method described by George Grey Turner [8] This part of the liver is usually thin and can be turned downward and held out of the way by a retractor This gives access to the cardia, and by gentle traction the lower end of the esophagus can be exposed A good sized vessel transverses the diaphragm

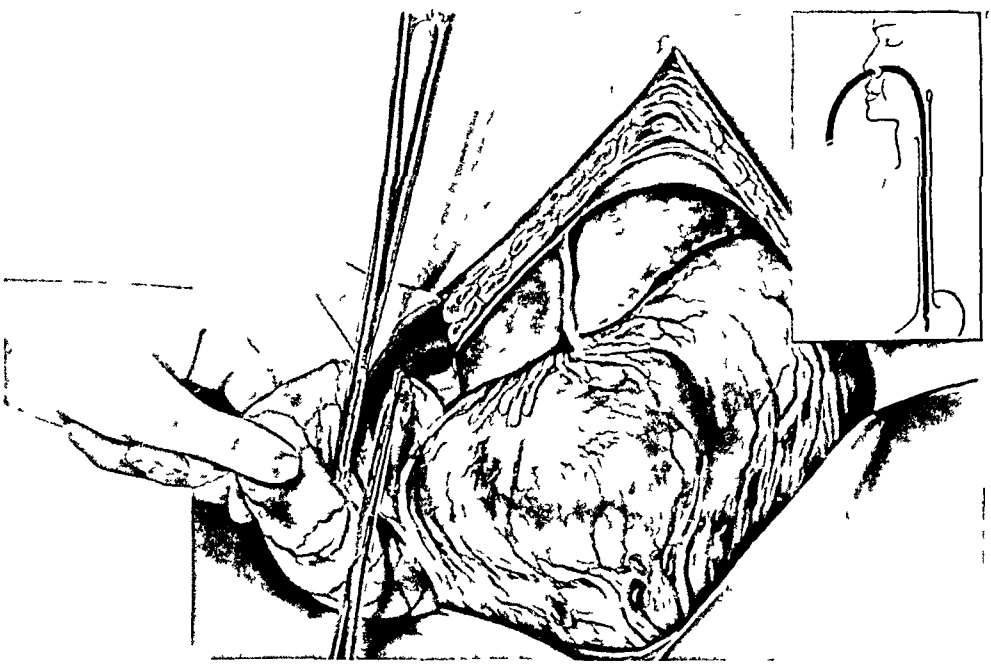


Fig 3 —The duodenum is freed and divided between clamps with the cautery, the proximal segment covered with gauze, and the distal end turned in

anterior to the esophageal hiatus and should be divided between clamps Vagus nerve branches are snipped, increasing the exposure so that from two to three inches of the lower esophagus can be brought into view The Levine tube is withdrawn by the anesthetist so that its tip rests in the lower esophagus, and care is taken that suction is maintained during the accomplishment of the anastomosis When possible, four right-angle half lengths are then applied to the esophagus which is severed at this point with the cautery (Fig 6)

A loop of jejunum is brought up through the gastrocolic omentum and sutured without tension to the diaphragm posterior to the cut end of the esophagus A small opening is then made in the jejunum at its apex and the clamps removed from the esophagus, one at a time, as this structure is sutured to the opening in the jejunum The final row of sutures fixes the anterior and lateral walls of the jejunum to the diaphragm so that these more reliable structures are solidly fixed entirely around the stoma (Fig 7) The Levine tube is then pushed down by the anesthetist and guided into the distal limb

Fig 4.—The dissection may be started from either side but if possible, it helps in freeing the gastrohepatic omentum if the greater curvature is freed first The gastro epiploic vessels and as much of the omentum as necessary are sacrificed

Fig 5.—The posterior wall of the stomach is always adherent to a peritoneal reflection from the lesser omentum Unless this is recognized, the middle colic vessels may be injured in the dissection

FIG 6.—The stomach has been entirely freed. The left lobe of the liver has been detached from the diaphragm. The lower end of the esophagus has been freed and brought down by gentle traction so clamps can often be applied. Inset shows the Levine tube withdrawn by the anesthetist so that its tip remains in the lower end of the esophagus and suction is maintained throughout the accomplishment of the anastomosis.

FIG 7.—(A) The jejunal loop has been brought up and fixed to the diaphragm behind the esophagus. (B C D E) A small opening is made in the apex of the jejunal loop and this is sutured to the cut segment of esophagus. (F) A final row of sutures hold the anterior surface of the jejunal loop to the diaphragm.

of the jejunum (Fig 8) An effort is made to place the stoma to the left of the inverted U of jejunum, in order that the food may pass into the distal limb

An entero-enterostomy is then effected between the ascending and descending limbs of jejunum at a point low in their course This allows duodenal contents to pass into the distal segment at a level lower than the esophagojejunal junction, and also obviates distention of the proximal jejunum and duodenum with food and salivary secretions (Fig 8)

A jejunostomy, for feeding purposes, is then constructed and brought through a small stab wound in the left flank (Fig 8) This has been found of great assistance since little is given by mouth for ten days after operation

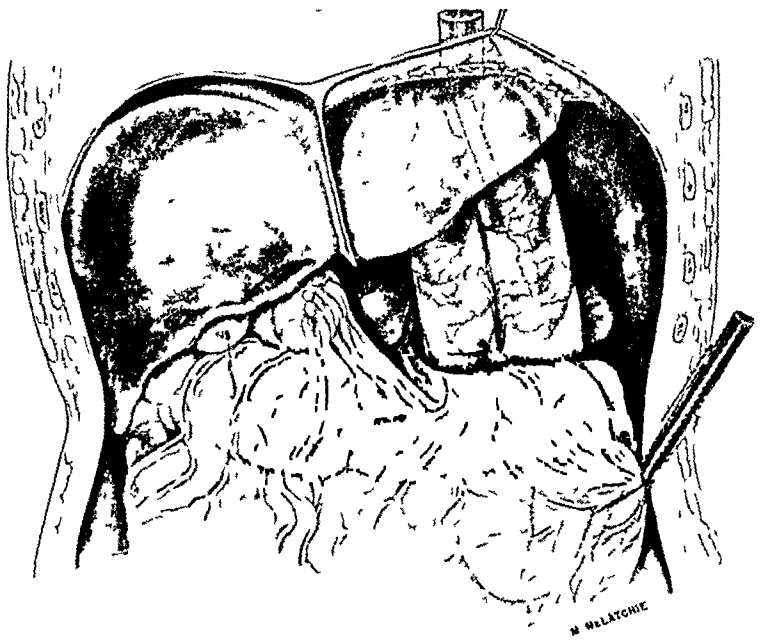


FIG 8—The Levine tube is guided into the distal limb of jejunum Entero enterostomy at a low level is then performed between the ascending and descending limbs The jejunostomy tube for feeding, is brought out through omentum and a stab wound in the left flank

We have felt that some of the previous failures were due to the poor suture line with which one must be contented in joining the friable structure of the esophagus to the jejunum Feeding through the Levine tube, as advocated by Finney and others, works well enough unless the tube becomes accidentally dislodged We have on occasion had some difficulty in replacing the tube to our satisfaction The Levine tube is left in place if possible for several days —usually five to seven The jejunostomy tube is not removed until the patient is taking an adequate amount of nourishment by mouth

We have had some difficulty in the past with diarrhea and stomatitis, as mentioned by Reid[9] and others The former is best controlled by food alterations rather than relying entirely on Ivy pabulum for nourishment Dilute hydrochloric acid added to the feeding apparently helped on one occasion

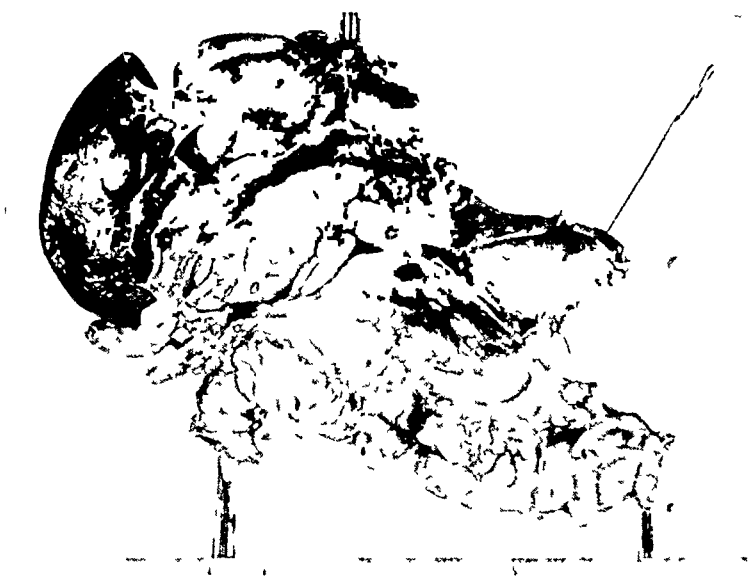
C vitamic acid before operation, and in the feedings afterwards, should eliminate stomatitis and assist wound healing [10]

On discharge from the hospital, these patients should be given a diet sufficient to maintain them and care should be exerted to feed them foods that will combat anemia It is our opinion that the anemias reported in some of the earlier cases of gastrectomy may have been due to the tendency of these

FIG 9



FIG 10



FIGS 9 and 10 —Photographs of the specimen removed at operation from the one patient that died among the entire seven total gastrectomies, in which the technic recommended had been employed The added segment of colon pancreas, and spleen which also had to be removed increased the operating time and the length of anesthesia which undoubtedly contributed to the subsequent pneumonia which caused his death

patients to avoid meat and rely entirely on liquid nourishment It has been surprising to find that the usual two-hourly feedings of liquids are gradually replaced with finely divided foods of all kinds These patients can finally take a reasonable meal at one time, and not only maintain their weight and strength but some of them gain in weight

Case Report—(The details of this patient's history have been previously reported[11]) The patient, J C, No 56,345, was a strong man, age 37, whose chief complaint was vomiting of blood and weight loss He had been treated a month previous to entry in another hospital for massive hemorrhage On exploration, it was found that an extensive gastric lesion had invaded the transverse colon and pancreas There were no distant metastases and the whole mass was movable All of the stomach, a segment of the transverse colon, two-thirds of the pancreas and the spleen were removed en bloc (Figs 9 and 10) The latter organ was included for simplicity in controlling the pancreatic blood supply Esophagojejunostomy, entero-enterostomy, jejunostomy for feeding, aseptic end-to-end suture of the colon, and a decompression cecostomy were all accomplished without incident The patient was in good condition at the end of the operation, which lasted three hours Pneumonia developed and at autopsy seven days later this was the only condition found incompatible with life The suture lines were firm and there was little evidence of intraperitoneal infection, there was, however, a slight amount of fat necrosis in the region of the transected pancreas Microscopic examination showed malignancy only in the central portion of a large ulcerative lesion The nodes were not involved We believe that the effort in this instance was warranted regardless of its magnitude and unfortunate outcome

TABLE II

TYPES OF ANASTOMOSES EMPLOYED IN 15 CASES OF TOTAL GASTRECTOMY

Massachusetts General Hospital, 1932–1937

	Cases	Recovered	Died
Esophagoduodenostomy	3	0	3
Esophagojejunostomy	1	0	1
Esophagojejunostomy and jejunostomy for feeding	2	1	1
Esophagojejunostomy and entero-enterostomy	2	1	1
Esophagojejunostomy and entero-enterostomy and jejunostomy for feeding	7	6	1
Totals	15	8	7

Table II gives some evidence, even in this small series of operations, that certain technical procedures are less trustworthy than others It is apparent that esophagoduodenostomy is less desirable than esophagojejunostomy, and this fact was emphasized in the results reported by Finney and Rienhoff When entero-enterostomy between the two limbs of jejunum plus jejunostomy for feeding is added, we seem to have enough evidence to warrant recommendation of these procedures We feel that the use of suction from within the esophagus during the time this structure is open, as advocated by Vincent, is an important safeguard against infection

REFERENCES

[1] Holmes, G W, and Hampton, A O The Incidence of Carcinoma in Certain Chronic Ulcerating Lesions of the Stomach J A M A, 99, 905, 1932

[2] Parsons, Landgon The Operative Curability of Carcinoma of the Stomach New Eng Jour Med, 209, 1096, 1933
[3] Benedict, E D Peritoneoscopy (In press)
[4] Finney, J M T, Sr, and Rienhoff, W F, Jr Gastrectomy Transactions of the Southern Surg Assn, 40, 424, 1927
[5] Roeder, C A Total Gastrectomy ANNALS OF SURGERY, 98, 221, 1933
[6] Vincent, Beth Personal communication
[7] Ogilvie, W H Some Points in the Operation of Gastrectomy Brit Med Jour, 1, 457, 1935
[8] Turner, G Grey Some Experiences in the Surgery of the Esophagus New Eng Jour Med, 205, 657, 1931
[9] Reid, Mont R Total Gastrectomy Surg, Gynec, and Obstet, 41, 667, 1925
[10] Lanman, T, and Ingalls, T Vitamin C Deficiency and Wound Healing ANNALS OF SURGERY, 105, 616–625, April, 1937
[11] Allen, A W Acute Massive Bleeding from the Upper Gastro-intestinal Tract (In press, Internat Clin)

DISCUSSION—DR J M T FINNEY, SR (Baltimore, Md)—It had seemed to me, for a long time before I had a favorable case on which to try it, that the operation of gastrectomy was perfectly feasible provided one carefully selected the case and then followed the line that Doctor Allen followed in his work, namely, the meticulous care exercised in every detail of the operation I have, for many years, insisted, in talking with my classes in Baltimore, that a very large part of good surgery consisted in attention to details With proper attention to detail, rigid asepsis, gentle handling of tissues, meticulous hemostasis—points so repeatedly emphasized by the late Doctor Halsted—great haste is unnecessary, and one can take time to carry out the details which Doctor Allen so properly insisted on in his paper

DR WALTMAN WALTERS (Rochester, Minn)—While only a relatively small number of cases are suitable for consideration for total gastrectomy, and there are fewer still in which the operation can be performed, nevertheless, the fact that the entire stomach can be removed successfully for malignant disease has a definite psychologic value This can be expressed not only in terms of the beneficial results that have followed total gastrectomy for carcinomatous lesions, but also in terms of the fact that there is every reason to emphasize the value of partial or subtotal removal when an entire organ can be successfully removed Emphasis of this point, I think, will encourage the suggestion of the possibility of removal, even when lesions appear extremely large or even occasionally when they appear inoperable during roentgenographic examination It should be remembered that roentgenologic examination of the stomach does not reveal the lesion itself but only the shadow of the outline of the stomach and the deformity produced by the lesion Under these circumstances it is frequently difficult for the roentgenologist to determine the amount of uninvolved fundus This possibility is the most frequent cause of regarding a lesion as inoperable when, at exploratory operation, sufficient normal stomach may be found above the lesion, frequently in the fundus, to enable partial or subtotal gastrectomy to be performed with restoration of gastro-intestinal continuity That such extensive resections are worth the risk is evidenced by the fact that, of a group of 184 patients, 40 were regarded by the preoperative roentgenograms as having lesions of doubtful operability and 15 were thought to have inoperable lesions In these 15 cases, in which the roentgenograms appeared to disclose inoperable lesions, but in which the lesions were removed by subtotal gastrectomy, it is interesting to

note that one patient lived for 12, another lived for eight, and two patients lived for six years after operation

Attention might be directed to the fact that there are some points in surgical technic that will aid in carrying out extensive gastric resections Among these are an approach to the lesion through a left rectus incision, the use of spinal or intratracheal anesthesia, and the willingness to resect a portion of the transverse mesocolon, pancreas or capsule of the liver if the lesion is attached to these structures When the patient strains under anesthesia, such attachment may lead one to the supposition that invasion of these structures, and particularly of the pancreas, may have occurred This might make one think that the lesion was inoperable, when, on better exposure and more careful study of the disturbed anatomy, superficial attachment rather than invasion might be recognized and the lesion separated In cases in which the patients are obese, removal of all of the gastrocolic omentum attached to that portion of the stomach to be removed has made the anastomosis of the remainder of the stomach to the jejunum much easier of accomplishment Of course, it is much safer and much better to leave a portion of the uninvolved fundus of the stomach whenever possible, rather than to remove the entire stomach, due largely to the better circulation of the gastric wall and because there is no doubt that the so-called intrinsic factor contained in gastric secretion in maintaining the erythrocyte content of the blood is definitely worth while, for many patients who have undergone total gastrectomy and have lived long enough seem to have developed a secondary anemia

After the performance of extensive partial gastrectomy, particularly the subtotal or the total type I have found it of distinct advantage to insert a catheter into the jejunum temporarily to permit feeding This allows one to keep the anastomosis as nearly at physiologic rest as possible for a long time In my three cases in which total gastrectomy was successful, jejunal feedings were continued for from 10 to 20 days following the operation The type of esophago-intestinal anastomosis is worthy of discussion In my first two successful total gastrectomies the anastomosis was made posterior to the colon and the opening in the mesocolon was attached to the esophagus Enteroanastomosis was not made In the last case the anastomosis was made anterior to the colon and an entero-anastomosis was made between the loops of jejunum comprising the esophagojejunostomy Postoperative roentgenograms in the three cases would seem to indicate that the anastomosis anterior to the colon is preferable, for it allows a larger area of the proximal portion of the jejunum to serve as a reservoir for food

In a series of cases in which total gastrectomy had been performed, which were collected from the literature by Finney and Rienhoff, in 1929, the average length of life varied from 12 to 18 months and the longest duration of life was four and one-half years, in a case reported by Zikoff In most of the cases in which patients have lived long enough after total gastrectomy to arrive at some definite decision as to changes in their physiology as a result of the loss of the stomach, the question whether the anemia that developed has been the result of the loss of the so-called intrinsic factor in gastric secretion, either independently or in association with recurrence of the carcinomatous process, has never been definitely answered

In most cases in which carcinoma involves the upper or middle part of the stomach there is usually uninvolved fundus remaining We have made use of this after removing the stomach by suturing the remaining cuff of fundus around the esophagus, thus protecting the lesser curvature A similar method was described by Judin, of Russia

The risk of total gastrectomy has been high, but the improvement in tech-

nic which Doctor Allen has described, the attachment of the jejunum to the diaphragm, seems to remove one possible cause of leakage, namely, tension on the anastomosis He had emphasized the importance of entero-anastomosis and I think it is well to do so In postoperative roentgenologic studies of our cases the proximal loop of jejunum seems to serve as a mixing chamber, taking the place of the stomach Following total gastrectomy, our patients seem to have an appetite for food, and experience hunger In my three cases the patients gained weight subsequent to operation In one case there was a gain of 15 pounds (6 8 Kg) subsequent to total gastrectomy

DIVERTICULA OF THE JEJUNUM

JOHN C A GERSTER, M D
NEW YORK, N Y

JEJUNAL and ileal diverticula (exclusive of Meckel's diverticula) represent the rarest form of diverticulosis affecting the gastro-intestinal tract

There has been much speculation indulged in regarding the etiology of these diverticula, and much stress has been laid upon differentiating between "true" diverticula, *i e*, containing all the coats of the intestine, and acquired or "false" diverticula, *i e*, pouchings of the mucous membrane with its submucosa through the muscular layer and thus becoming covered only by the overlying serosa

In the case reported by Schmidt and Guttman,[111] in 1934, three diverticula of the duodenum and multiple diverticula in proximal 50 inches of jejunum, both "true" and "false," were present and many transition stages between the two forms were noted These authors state "It would be less confusing to designate these diverticula simply as pulsion diverticula without reference to the presence or absence of the muscularis externa"

Godard, Bourdial and Zourekatis,[43] in 1932, reported a case of a female, age 39, operated upon for acute intestinal obstruction, from whom 70 cm of jejunum, containing 25 diverticula, were resected Five years later, after demonstration of new jejunal diverticula roentgenographically, 80 more cm of intestine, containing 26 diverticula, were resected According to them, this would tend to indicate an acquired origin of the diverticula, as none was evident at this site five years previously

Klebs,[72] in 1869, pointed out the relationship of diverticula to vessels

Edwards,[28] in 1936, makes out a very good argument elaborating the theory that atypical spasms of the small intestine, as shown roentgenologically in duodenal ulcer cases, might likewise occur in the jejunum and this atypical type of simultaneous spasm at two points, with relaxation in the segment of the gut between, plus the tendency to herniation through weak spots in the musculature at points of vascular perforation, may account for development of jejunal diverticula Rosedale,[103] a pathologist, holds the same opinion

Certain authors, most recently R W Butler,[10] suggested traction secondary to sclerosis of mesenteric vessels as a possible predisposing factor This theory seems to be ruled out in part by the findings in four of Rosedale's seven cases, who found no sclerosis of the vasa recti either grossly or microscopically

Lewis and Thyng,[78] in 1908, reported on the regular occurrence of intestinal diverticula in mammalian embryos, notably those of the rabbit, pig and man

Associated diverticulosis of the duodenum and colon has been noted in a considerable number of cases Diverticulosis of the colon is the most com-

mon, next, single and multiple diverticulosis of the duodenum, and lastly, a single and multiple diverticulosis of the jejunum The upper jejunum is the most frequent site of diverticular involvement

Diverticula may be single or multiple—as many as 400 or 500 have been reported Their size varies from that of a lentil to that of a mandarin orange or even larger Their openings into the intestine are usually wide Stagnation of their contents is exceptional This explains the rarity of their demonstration roentgenologically Occasionally, however, stagnation does occur Four cases of intestinal obstruction from enteroliths arising in jejunal diverticula are reported (Christ,[20] Renaud,[100] Terry and Mugler,[126] and Watson*[132]) One foreign body, a piece of bone, was reported by Ogloblina[92] Two instances of intestinal parasites are noted (Gomard and Courrier,[44] and Rosedale)

At first they were discovered at autopsy More recently a considerable number have been found during the course of celiotomies performed for other conditions And still others have required operation as a result of stagnation, inflammation, or intestinal obstruction from pathologic conditions in the diverticula themselves

Undoubtedly, jejunal diverticula occur more frequently than has hitherto been supposed Rosedale, in 1935, reported three cases of multiple diverticula of the jejunum among 5,000 autopsies Yet, in 1936, as a result of routine insufflation of the small intestine *in situ* under moderate air pressure, he found four cases among 300 autopsies Guthrie[50] holds the same opinion regarding their greater frequency

In most cases the diverticula have given rise to no symptoms In others, vague gastro-intestinal symptoms, aptly described by Edwards as "flatulent dyspepsia," that is, epigastric pain and discomfort accompanied by a certain amount of flatulence an hour or two after meals, have been the outstanding feature Lastly, there have been cases of perforation with peritonitis Some of these perforations have been rather slow, permitting the walling-off and localization of the inflammatory process Others have been fulminating and acute (Case 1)

The diagnosis has occasionally been made, since 1920, roentgenologically In fact, while this is the only positive diagnostic criterion, it is not very reliable, as there are instances where multiple diverticula found during celiotomy could not be demonstrated roentgenologically after operation, notwithstanding their known existence Rankin and Martin,[98] in 1934, reported that among 956 cases of "stasis examinations" of the small intestine, in only three instances were diverticula of the small bowel demonstrated Yet, diverticula were found 18 times at operation for other conditions in their series of 52 cases

Sometimes roentgenologic examination with the patient erect reveals the partly filled diverticula as a series of horizontally surfaced half moons of dif-

*Zengerle (cited by Kaspar) reported enteroliths in jejunal diverticula but failed to mention the outcome

ferent sizes to the left and below the stomach, each with its own supernatant gas bubble In the early films they were interpreted as multiple points of partial obstruction from tuberculous peritonitis until the subsequent operation showed them to represent jejunal diverticula

In other instances, irregularly rounded, barium pockets remained after the small intestine had become empty Their position changed (within a range of several inches) upon change in posture or by palpation under the fluoroscope

In certain of these, high up in the jejunum, partly visible above the lesser curvature of the stomach, the superimposed shadows gave the picture of a penetrating gastric ulcer Lateral and oblique views and serial studies in different postures were necessary to establish the correct diagnosis

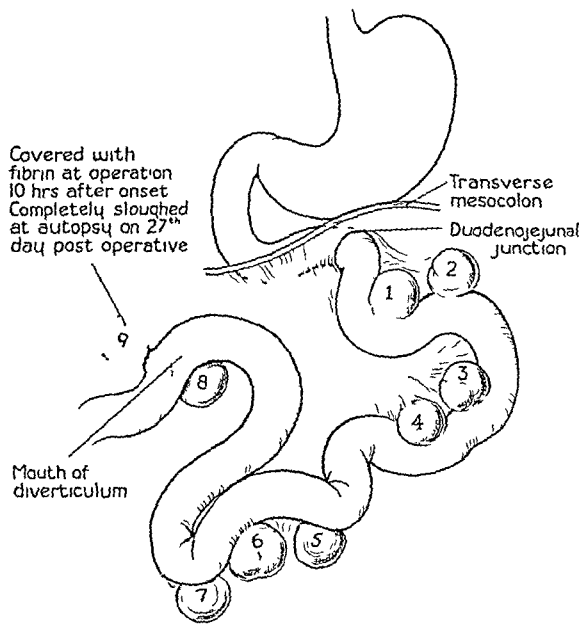


FIG 1—Diagram representing multiple (9) large "false" diverticula of the upper jejunum Numerous smaller diverticula also present Diffuse peritonitis from perforation of lowermost diverticulum Operated upon eleven hours after onset Death from uremia and cardiac failure on twenty seventh day postoperative The perforated diverticulum had completely sloughed away

Indications for Treatment—If multiple diverticula are found by chance at operation, or in the roentgenogram, and symptoms point to some other lesion, they should be left alone In Rankin and Martin's series of 52 cases of the diverticula of the small bowel, no case was operated upon for symptoms thought to arise from the diverticula

On the other hand, there is a group of cases exhibiting the so-called "flatulent dyspepsia" of Edwards, lasting for months or years In a number of these, side-tracking entero-anastomoses did not improve matters, and secondary resections were necessary to obtain relief The only exception to this was the case of Godard, Bourdial and Zourekatis, previously referred to where a resection of 80 cm of affected jejunum was followed by a second

resection five years later, following development of additional diverticula in a segment of gut not showing any present at the first operation

In other instances a large, single diverticulum has been excised and intestine infolded Two or three times the lumen of the intestine was so narrowed by the excision that an entero-anastomosis was necessary In other cases the diverticula themselves were simply infolded

Still another group of cases showed subacute and acute perforation with their various complications Of these, some give a history of previous attacks, mistaken for gastric or duodenal ulcer or appendicitis until their true cause was revealed at operation Others, however, gave no previous history of any digestive disturbance prior to a sudden onset (Butler,[10] Spackman[117]) Case 1 belongs to this category

It is apparent, therefore, that the choice of procedure will depend upon the exigencies of each case



FIG 2.—Autopsy specimen Multiple false jejunal diverticula

Case 1.—A T, male, age 51, a brewery employee, was admitted at 4 A M, May 19, 1935, to the Lenox Hill Hospital, service of Dr DeWitt Stetten He had always been healthy, had enjoyed excellent digestion and for years had been accustomed to drink 60 glasses of beer daily Nine and one-half hours before admission, there was a sudden onset of abdominal pain accompanied by vomiting *Physical Examination* showed a very obese man, acutely ill, with signs of a diffuse peritonitis A tentative diagnosis of a perforated diverticulum of the sigmoid was made

Operation.—(11 hours after onset) A diffuse, generalized peritonitis with free fluid was found Beginning about 20 cm below the duodenojejunal angle were nine large diverticula of the jejunum situated along the mesenteric border at intervals of a few inches for about 100 cm, six on the left and three on the right (Figs 1 and 2) All except the lowermost (No 9), were healthy in appearance and could be invaginated Their size varied between that of a small mandarin orange and a golf-ball The last diverticulum was covered with fibrin and was obviously the cause of the peritonitis No gross perforation was to been seen The patient's condition did not permit doing anything more than the placing of rubber dam drains to the region of the affected diverticulum and to the pelvis The peritoneal fluid showed pure culture of *Bacillus coli communis*

Postoperative Course.—There was fair postoperative recovery and free drainage of

serous fluid for a few days After the seventh day an impending uremia (urea-nitrogen had increased to 62 5 mg) responded to treatment within a day or two Also about this time, there occurred a partial escape of small intestinal contents from the drainage tract to the diverticulum The general condition was only fair Although his sensorium was clear, and he took food and liquids freely, and his bowels moved with enemata, his circulation was poor, the extremities were always cold and clammy, and there was profuse sweating The abdomen was flat, with normal temperatures between the 17th and 25th days, when again signs of increased cardiac failure and uremia supervened which did not respond to treatment Death occurred on the 27th postoperative day

Autopsy showed no peritonitis except for adhesions at the point where the inflamed diverticulum (No 9) had been drained The latter was found to be completely sloughed down to its opening in the intestinal wall The specimen shows a large beer drinker's stomach, eight large diverticula of the upper jejunum and only the mouth of the ninth On inflation many small, additional diverticula became evident

The heart was small and flabby, and weighed 325 Gm There was an atrophic cirrhosis of the liver It seems probable that a thrombosis of the vessels supplying the affected diverticulum was followed by necrosis with perforation and subsequent sloughing of the entire diverticular wall

Carl Eggers has kindly furnished the author with the following data of a hitherto unpublished case

Case 2—(Dr Carl Eggers) I W, female, age 62, had a gastro-enterostomy performed for pyloric stenosis due to ulcer, at the Lenox Hill Hospital, New York, November 19, 1927, in addition to which there was a penetrating ulcer high up on the lesser curvature In the course of the operation, multiple (12) diverticula of the jejunum along the mesenteric border, diminishing in size from above downward, were found These varied in size from a walnut to a hazelnut Nothing was done to the diverticula Postoperative roentgenologic examination showed no gastric retention and, repeated two years later, gave the same result The roentgenograms showing the diverticula were unfortunately lost

CONCLUSIONS

Although diverticulosis of the jejunum occurs more infrequently than elsewhere in the gastro-intestinal tract, its incidence is probably greater than has hitherto been suspected

A large proportion of diverticula of the jejunum give no symptoms They are discovered most frequently either at autopsy or during an operation for some other condition

A second group gives rise to symptoms of so-called "flatulent dyspepsia" (Edwards) over a period of months or even years Excision of a large solitary diverticulum, or resection of the jejunal segment bearing multiple diverticula, has given relief

Still another group with acute attacks from time to time, eventually develops chronic intestinal obstruction from kinking of the intestines by adhesions to previously inflamed diverticula

There is a group that presents no history of antecedent illness, which suddenly experiences acute perforation of a hitherto silent diverticulum

For the reader's convenience, brief abstracts and explanatory notes have been appended to the list of bibliographic references Unless specifically

stated otherwise, the diverticula mentioned in these notes, were situated along the mesenteric border of the jejunum

BIBLIOGRAPHY

128 REFERENCES, RECORDING 187 CASES OF JEJUNAL DIVERTICULA, OF WHICH 135 HAVE BEEN ABSTRACTED

[1] Adams, J E Surgery of the Jejunum (Hunterian Lecture) Brit Jour Surg, 14, 345, 1926
States distinction between "false" and "true" (diverticula) largely artificial

[2] Albrecht, H W Die Rontgendiagnostik des Verdauungskanals, 321–322 Leipsig Georg Thiem, 1931
Figs 610 and 611 show multiple jejunal diverticula They filled and emptied rapidly—an elderly female with 60 diverticula in all

[3] Balfour, D ANNALS OF SURGERY, 57, 902, 1913
Male, age 62 Anterior gastro enterostomy for callous pyloric ulcer, four paramesenteric jejunal diverticula

[4] Beer, E Some Pathologic and Clinical Aspects of Acquired 'False" Diverticula of the Intestine Am Jour Med Sci, 128, 135, 1904
Interesting treatise on etiology—no cases

[5] Berner (ref Weiss[133])
(1) Female, age 90, pneumonia, autopsy, multiple (67) jejunal diverticula
(2) Fourteen diverticula, 70 cm of the small intestine

[6] Boling, J R A Case of Multiple Diverticula of the Jejunum, with Resection J A M A, 95, 267, 1930, also 96, 526–527, 1931
Male, age 58, oper No 1 for intestinal obstruction—multiple (53) diverticula found —obstruction relieved Oper No 2, nine months later for obstruction, resection of 60 inches of jejunum, recovery

[7] Birch-Hirschfeld Lehrb d Pathol Anat, 2, 550, 1887
Brief description of paramesenteric diverticula of small intestine

[8] Braithwaite, V Guy's Hosp Gaz, 32, 77, 1918
Male, age 45, autopsy—dead from pneumonia, multiple diverticula of jejunum, also two in duodenum Mentions two similar cases of multiple diverticula of small intestine in past 30 years occurring at Guy's Hospital

[9] Buckstein, J The Duodenogram Applied to the Demonstration of a Duodenojejunal Diverticulum Am Jour Surg, 3, 340–341, 1927
"Duodenogram" obtained by swallowing duodenal tube until it lies beyond duodenojejunal junction, then injecting barium Demonstrates that by this means a diverticulum of jejunum can be differentiated from a penetrating ulcer of lesser curvature, roentgenograms but no case report

[10] Butler, R Weeden Observations upon Multiple Intramesenteric Diverticula of the Small Intestine Brit Jour Surg, 21, 329–346, 1933–1934
Case 1—Autopsy, female, age 65, carcinoma of colon, 20 jejunal diverticula—no symptoms during life
Case 2—Male, age 63, two years history of abdominal symptoms *Roentgenologic diagnosis made*, celiotomy—hundreds of diverticula, nothing done, recovery
Case 3—Male, age 61, autopsy, arteriosclerosis, 50 diverticula—history of "flatulent dyspepsia"
Case 4—Female, age 72, operation 12 hours after onset of symptoms, multiple diverticula—one perforated—resection of two feet of intestine, recovery
Case 5—Male, age 56, operation 12 hours after onset, perforation of one of five large diverticula, resection, death on fourth day
Case 6—Female, age 72, operation 36 hours after onset, seven diverticula, one perforated with abscess, resection, death from uremia six days postoperative

Case 7—Male, age 64, operation 24 hours after onset, great many diverticula—inflammation with localized peritonitis around upper jejunum—nothing further done—closure—recovery (probably diverticulitis of sigmoid as well)

Traumatic Rupture of Intramesenteric Diverticula of the Jejunum Brit Jour Surg, 25, 277–279, October, 1937

Male, age 42, "never had a day's illness", kicked by a horse, celiotomy, ruptured intramesenteric diverticulum found and closed—two other unruptured diverticula noted Death ten hours after operation Autopsy, additional ruptured diverticulum which had escaped observation at operation

[11] Braithwaite, L R A Case of Jejunal Diverticula Brit Jour Surg, 11, 184, 1923–1924

Male, age 54, "flatulent dyspepsia" for 30 years Fifty paramesenteric diverticula, four feet of intestine resected at second operation after sidetracking anastomosis had proved ineffective *Diverticula demonstrated roentgenologically*

[12] Briggs, P J, and Hurst, A F Diverticulum at Duodenojejunal Flexure Simulating Radiologically a Gastric Ulcer Guy's Hosp Rep, 82, 106–113, 1932

No operation—cites other radiologists' experience

[13] Brites, G Trois cas de Diverticules du Jejunum, Folia anatomica Univ Conimbrigensis (Lisbon), 2, 1–8, 1927

Three autopsy cases Male, age 19, one diverticulum, male, age 65, four diverticula, female, age 74, two diverticula

[14] Brandes, K Uber Dunndarmdivertikel, Nebst einem Beitrag zur Beobachtung eines horizontalen Dunndarmdivertikels bei einem Darmlipom Deutsch Ztschr f Chir, 215, 390–402, 1929

Child, age six—single diverticulum on convexity of jejunum associated with a lipoma

[15] Berry, J A Multiple Diverticula of Jejunum Lancet, 2, 496, 1927

Male, age 70, uremia Autopsy—50 diverticula in first six feet of jejunum Two mesenteric lipomata not associated with diverticula

[16] Buchwald, A, and Jamicke, O Ueber Darmcystem (Enterokystome) als Ursache eines completen Darmverschisses Deutsch med Wchnschr, 23, 868, 1887

Male, age six, operation, two large double cystlike "true" diverticula on mesenteric border—compressed jejunum causing intestinal obstruction—resection, died

[17] Buxton, St J D A Case of Diverticulum of the Jejunum Jour Anat, 58, 84–87, 1924

Male, age 48, autopsy, cerebral thrombosis—one "true" diverticulum, 18 inches below duodenojejunal angle, on mesenteric border

[18] Buzzi Arch f path Anat, *etc*, 100, 357, 1885

Male, age 77, autopsy, carcinoma of stomach, one diverticulum on mesenteric border —"true" type

[19] Case, J T Diverticula of Small Intestine Other Than Meckel's Diverticulum J A M A, 75, 1463, 1920

(1) Male, age 61, "flatulent dyspepsia" for years *Diverticulum of jejunum demonstrated roentgenologically* Operation—multiple jejunal diverticula, resection, recovery

(2) Male, age 71 Diagnosis of jejunal diverticula demonstrated roentgenologically Operation, recovery

Jejuno-ileal Diverticula Acta radiol (Stockh), 6, 230–240, 1926

Reports *eight more cases diagnosed roentgenologically* No further details

[20] Christ, A Multiple Divertikel des Jejunum, Anatomische und klinische Beitrage zur Kenntnis eines seltenen Krankheitsbildes Deutsch Ztschr f Chir, 236, 560–570, 1932

(1) Male, age 58, three years of "flatulent dyspepsia" Celiotomy—40 diverticula

found by chance, adhesion to stomach divided Recovery Good roentgenograms taken *after* operation (illustration)

(2) Male, age 60, three days acute abdominal symptoms Operation—obstruction of ileum by mushroom-shaped coprolith, 6 by 4 by 3 cm, displaced from a diverticulum, 40 to 50 other diverticula Enterotomy, recovery

[21] Christie, G W Acute Inflammation of a Large Diverticulum of the Jejunum with Perforation Brit Med Jour, 1, 990–991, 1922

Female, age 48, years of "flatulent dyspepsia", subacute perforation with retention of contents Excision of diverticulum resulted in narrowing of lumen requiring entero-anastomosis—recovery

[21a] Chapman, J Report of a Case of Diverticulosis of the Small Intestine and Critical Review of Recent Literature Ann Int Med, 7, 376, 1934

Male, age 66 Autopsy, multiple diverticula of jejunum, also diverticula of colon

[22] Chlumsky, V Experimental Work on Methods of Intestinal Anastomoses Beitr z klin Chir, 15, 539, 1899

[23] Cokkinis, A J Observations on the Mesenteric Circulation Jour Anat, 64, 200, 1930

[24] Cook and Hunt Jejunal Diverticula Annals of Surgery, 74, 746, 1921

(1) Male, age 54, "flatulent dyspepsia" for 15 months *One diverticulum demonstrated roentgenologically*, operation, excision of diverticula Recovery

(2) Male, age 44, autopsy, one diverticulum of jejunum

[25] Cooper, Sir Astley The Anatomy and Surgical Treatment of Abdominal Hernia, Philadelphia, Lea and Blanchard, p 364, 1844

Male, age 50, autopsy, multiple jejunal diverticula, also cirrhosis of liver, intestinal obstruction, inguinal and femoral herniae

[26] Cornillon Bull Soc Anat de Par, 44, 525, 1869

Female, age 30, autopsy, placenta previa, single jejunal diverticulum in mesentery

[27] Edel, M Arch f Path Anat, 138, 347, 1894

Female, age 73, autopsy, seven jejunal diverticula, colonic diverticulosis

Edel states diverticula arise to one side or the other of the mesentery, especially the smaller ones Hansemann has made the same observation

[28] Edwards, Harold C Diverticulosis of the Small Intestine Annals of Surgery, 103, 230–254, February, 1936

Twelve cases Found at autopsy, seven, at operation, three, *roentgenologically, two*

(1) Male, age 55, autopsy, no symptoms during life—18 jejunal diverticula

(2) Female, age 38, "flatulent dyspepsia" for six to eight years *Preoperative roentgenologic diagnosis positive* Resection Recovery The resected segment of intestine showed six or eight diverticula and also a nodule of aberrant pancreatic tissue on the antimesenteric aspect of the bowel

(3) Female, age 63, no history Autopsy, six diverticula of upper jejunum

(4) Male, age 48, autopsy, no symptoms during life, single diverticulum

(5) Male, age 7, specimen received from Madras Solitary diverticulum

(6) Female, age 62, solitary diverticulum (antimesenteric) found at autopsy

(7) Female, age 57, autopsy, malignant tumor in neck of diverticulum (patient died of "malignant disease")

(8) Male, age 53, acute onset (24 hrs) Operation, acute inflammation of diverticulum Resection, recovery

(9) Male, age 49, abdominal complaints for six years *Diagnosed roentgenologically* Excision of diverticulum, lumen of intestine narrowed, necessitating posterior gastro-enterostomy

(10) Male, age 55 Gastric ulcer *Preoperative roentgenologic demonstration of ulcer and jejunal diverticulum positive* Operation, partial gastrectomy, diverticulum not disturbed Death

(11) Male, age 69, "flatulent dyspepsia" for 18 months *Roentgenologic examination showed several jejunal diverticula, also diverticula of the colon* No operation
(12) Male, age 67, abdominal symptoms for two years *Roentgenologic examination showed two jejunal diverticula* No operation

[29] Eggers, Carl (personal communication)
Female, age 62, one chronic gastric ulcer at pylorus, another high on lesser curvature Gastro-enterostomy Multiple (12) jejunal diverticula found during operation for ulcer A few of these showed roentgenologically postoperative Recovery

[30] Erdmann, John F ANNALS OF SURGERY, 73, 244, 1921
Mentions having seen diverticula of the small gut

[31] Fischer, Martin H "False" diverticula of the Intestine Jour Exper Med, 5, 333, 1900–1901
Pathologic specimens (1) Single paramesenteric diverticulum of jejunum (2) Multiple "false" diverticula along mesenteric border of ileum

[32] Follhasson, Andre Diverticula unique due jejuno-ileon Ann d'Annat path, 42, 672–674, 1927
Describes a specimen of a single paramesenteric diverticulum No history

[33] Fagge, Hilton (ref Treves[157]) New revised edition, 1899, shows two specimens of jejunal diverticulosis and one single diverticulum of the jejunum with perforation—containing a pea, Fig 21, p 61

[34] Fort, F T Solitary Jejunal Diverticulum of Long Duration, Complete Intestinal Obstruction, Operation, Recovery Kentucky Med J, 19, 1921, Trans S Surg, 41, 292, 1928
Male, age 24, for eight years attacks of abdominal intermittent pain, acute onset, celiotomy—large antimesenteric diverticulum, resection (12 cm) of intestine, recovery

[35] Fraser, I Diverticula of the Jejuno-Ileum Brit J Surg 1933, 21, 183, 1933
Female, age 30 (three previous attacks) Sudden onset, diagnosis, perforated gastric ulcer, operation on third day—perforation with abscess, intestinal obstruction, resection of four feet of involved intestine, recovery *Subsequent roentgenologic examination showed some diverticula still present*

[36] Glaus (ref Kaspar[76]) Schweiz med Wch, 50, 1024
Female, age three, autopsy, congenital diverticulum and jejunum (ref also Buchwald and Janicke,[16] and Moore[85])

[37] Gant, S G Diverticula, Diverticulitis and Peridiverticulitis J A M A, 77, 1415–1420, 1921
Cites no cases of jejunal diverticula

[38] Galindez, A, et A Bianchi Diverticulos multiples del Ileon Semana Med, 34, 640, 1927
Male, age 53, autopsy, multiple diverticula

[39] Gordinier, H C, and Sampson, J A Diverticulitis (Not Meckel's) Causing Intestinal Obstruction J A M A, 46, 1585, 1906
Female, age 45, three weeks' acute abdominal symptoms Operation, 13 "false" diverticula of jejunum—one inflamed causing adhesions and obstruction—this one excised, drainage to stump Recovery

[40] Gisbertz, H Multiple Dunndarmdivertikel Arch klin Chir, 165, 314–321, 1931
Male, autopsy, pulmonary tuberculosis, mesenteric tuberculosis, 300 "false" diverticula of small intestine *Some shown roentgenologically before death* Simple exploratory celiotomy Nothing done

[41] Gladtke, Martin Dunndarmdivertikel Deutsch Ztschr f Chir, 224, 345–347, 1930
Female, age 14, volvulus of small intestine—resection of five feet, recovery Specimen shows a Meckel's diverticulum and distal to this, widening of the intestine to the size of an infant's head along mesenteric border, also an intramesenteric cyst

with four openings into the intestine, microscopic examination showed all coats present in cyst wall

[4] Godard, H Le diverticulose jejuno-ileale Rev de Chir, 65, 22, 1927 (Quoted by Fraser [30])
Same case as described in next reference

[47] Godard, H, Bourdial, and Zourekatis, T Un cas de diverticulose jejuno-ileale Am d'anat path, 9, 311–315, March, 1932
Female age 39, acute intestinal obstruction, volvulus of intestine, also diverticulosis of jejunum Operation, volvulus untwisted, 70 cm of jejunum resected (25 diverticula) Five years later a second resection (*after roentgenologic demonstration of new diverticula*), 80 cm more resected showing 26 diverticula—ten on left, 16 on right of mesentery This speaks for acquired origin of diverticula None present at this site at first operation

[44] Gomard, P, and Courrier, R Sur la Constation de Parasites Dans des Diverticules Multiples du Jejunum Ann d'Anat Path, 6, 189–196, February, 1929
Female, age 61, profoundly ill, abdomen distended, fecal vomiting Exploratory celiotomy Jejunal diverticulosis with inflammation Death Autopsy Multiple diverticula—eggs of strongyloides intestinalis

[45] Gomard, Pierre, Gomard, E, et Chevaux Presentation d'une diverticulose de jejunum Resume Presse med, 1, 298, 1928
Female, age 71, chronic obstruction Autopsy Multiple (65) diverticula along one meter of jejunum

[46] Goldfarb, S J The Roentgen Diagnosis of Lesions of Small Intestine N Y State Jour Med, 34, 500, 1934
Describes technic and reviews general considerations No case reports

[47] Good Inaugural Dissertation, Zurich, 1895
Female, age 77, autopsy, six jejunal diverticula, one duodenal

[48] Graser Arch klin Chir, 59, No 3, 1899
Discussion on etiology of "false" diverticula No case reports

[49] Grassberger, R Wien klin Wchnschr, 10, 149, 1897
Male, age 73, autopsy, perforated duodenal ulcer, one jejunal diverticulum, one diverticulum of stomach, two of the duodenum, and multiple diverticula of the colon

[50] Guthrie, D, and Hughes, F A, Jr Diverticulosis of the Small Intestine Surgery, 1, 595–609, April, 1937
(1) Male, age 71, digestive disturbances, preoperative roentgenologic examination negative for diverticula Operation Resection of five feet of jejunum containing multiple (70) diverticula Death
(2) Male, age 61, "flatulent dyspepsia" for one year (1) Gastro-enterostomy for duodenal ulcer—vicious circle—for this a second entero-enterostomy, recovery At second operation three jejunal diverticula were found, the larger two of which were excised
(3) Male, age 54, several large hemorrhages from bowel, transfusion *Roentgenologic examination showed jejunal diverticula* Operation Resection of 19 inches of jejunum which contained 22 diverticula Recovery

[51] Hansemann Virchows Arch, 144, Arch f path Anat, 138, 347, 1896
Male, age 85, autopsy, 400 jejunal diverticula

[52] Harttung Dunndarmdivertikel mit eigemartigen klinischen Erscheinungen Arch klin Chir, 143, 234–237, 1926
Female, age 66, resection of 20 cm of jejunum for intramesenteric cyst, which extended to both sides of mesentery, and was hen's egg in size Recovery

[53] Heidecker Multiple Divertikelbildung des Duodenum und Jejunums Ref XV Taggsudostdtsch Chir ver gbl Chir, 3, 2728, 1927 Bruns Beitrage zur klin Chir, 142, 776, 1928
Male, age 54, multiple diverticula, "flatulent dyspepsia"—celiotomy, multiple diver-

ticula (30) of jejunum, seven months later second operation, resection of involved intestine Recovery

[58] Helvestine, F "False" Diverticula of the Jejunum Surg, Gynec, and Obstet, 37, 1, 1923
(1) Male, age 70, autopsy, 58 jejunal diverticula—old prostatic, one bladder diverticulum—death from uremia
(2) Female, age 59, autopsy, peritonitis from ruptured gallbladder, one "false" diverticulum on antimesenteric border

[59] Hodenpyl Proc New York Path Soc, p 182, 1900
Pathologic specimen of duodenum and upper jejunum seat of a number of thin-walled cysts (diverticula)

[60] Hunt and Cook Jejunal Diverticula ANNALS OF SURGERY, 74, 746, 1921
(1) Male, age 54, "stomach trouble" for 15 months *Preoperative roentgenologic diagnosis of* diverticulum of jejunum Excision of diverticulum 3 by 3 cm Recovery
(2) Male, age 44, acute onset 12 hours—appendicectomy—sudden death two days later One jejunal diverticulum found at autopsy

[61] Hunter, J L A Mesenteric Cyst of Jejunal Origin Complicated by Retrojejunal Position of the Transverse Colon Brit Med Jour, 2, 800, 1922
Child, age seven days, autopsy, large, bilocular mesenteric cyst compressing jejunum 10 cm beyond the duodenojejunal flexure Cyst "originated as an enteric diverticulum" (Ref Buchwald and Janicke's[10] case)

[62] Jenkinson, Edward L Diverticula of the Small Bowel Radiol, 12, 100–105, 1929
Male, age 59, "flatulent dyspepsia" for three years *Roentgenologic diagnosis positive,* and confirmed at operation Five feet of jejunum showed diverticula Recovery Symptoms unchanged

[63] Johnson, E A Diverticula Spuria Intestinalis Australian Med Gaz, 25, 333, 1906
Male, age 90, autopsy, multiple large (3 by 2 inches) diverticula of jejunum, also a diverticulosis of the colon

[64] Jones, T J, and Crile, G, Jr Diverticula of Jejunum, Report of 4 Cases Am Jour Digest Dis and Nutrit, 3, 120–122, April, 1936
(1) Male, age 32, "flatulent dyspepsia" for two years Operation, excision of jejunal diverticulum, recovery
(2) Female, age 67 *Roentgenologic examination showed two duodenal diverticula and many others in the small intestine* No operation
(3) Male, age 42, "dyspepsia" for ten years Presumptive diagnosis *duodenal ulcer* and one diverticulum of jejunum (probable) No operation
(4) Female, age 40, three months' abdominal symptoms *Roentgenologic findings* Diverticula of duodenum (1), of duodenojejunal junction (1), and "one farther along in the small intestine" Operation Multiple diverticula of small intestine—larger ones excised Recovery

[70] Kaspar, Fritz Der Divertikelileus Arch klin Chir, 141, 389–418, 1926
Male, age 49, attacks of abdominal pain for many years Celiotomy for intestinal obstruction due to old adhesions to diverticulum, other multiple diverticula, invagination and suture, entero-anastomosis, recovery

[71] Keith, A Diverticula of the Alimentary Tract of Congenital or of Obscure Origin Brit Med Jour, 1, 376, 1910
Cites seven specimens of multiple diverticula of jejunum in London

[72] Klebs Handbuch der pathologischen Anatomie, 1869

[73] Kornmann (ref Kaspar[70]) Zent f Chir, 1, 1912
Female, age 85, autopsy, multiple (62) jejunal diverticula

[74] Levy, J S, and De Groat, A Diverticula of Jejunum, Review of Literature and Report of Two New Instances Am Jour Digest Dis & Nutrit, 1, 708–713, December, 1934
(1) Male, age 75, vagabond American Indian, autopsy, multiple (25) diverticula

(2) Female, age 42, ten years "flatulent dyspepsia" *Roentgenologic diagnosis positive*, one "false" diverticulum Excision, recovery (gallbladder and appendix also removed)

[76] Lambret, O, et H Surmont Un cas de diverticules multiples du jejuno-ileon Arch des Mal Appar digest, 18, 765–771, 1928
Male, age 50, many previous abdominal attacks, obstructive crisis Multiple diverticula on mesenteric border Resection of 50 cm Recovery

[77] Latarjet and Murad Lyon chir, 11, 425, 1914
(1) Female, age 50, autopsy, one large diverticulum at duodenojejunal angle
(2) Male, age 71, autopsy, multiple jejunal diverticula

[78] Leriche, R Sept diverticules jejunaux, dont un tres volumineux immediatement apres l'angle duodeno-jejunal Bull et mem Soc Nat de chir, 58, 1044–1045, July 9, 1932
Male, age 61, symptoms 40 yrs *Roentgenologic diagnosis positive* Excised one large diverticulum Recovery

[79] Lewis, F J, and Thyng, F W The Regular Occurrence of Intestinal Diverticula in Embryos of Pig, Rabbit, Man Am Jour Anat, 7, 505, 1907–1908

[80] MacKechnie, H N Diverticula of the Jejunum Annals of Surgery, 74, 96, 1921
Female, age 43, markedly asthenic, "flatulent dyspepsia" for several years Operation, 13 jejunal diverticula, three duodenal diverticula, gastro-jejunostomy, death Autopsy

[81] McMurrich, J P, and F F Tisdall A Remarkable Ileal Diverticulum Anat Rec, 39, 325–338, 1928
Male, age one year (13 mo), autopsy, paramesenteric "true"

[82] McWilliams, C A Annals of Surgery, 73, 135, 1921
Male, age 71, acute abdominal symptoms for 24 hours Autopsy, mesenteric thrombosis, seven "false" jejunal diverticula

[83] Merkelbach, O Jejuno-ileal-Divertikel Ztschr f Klin Med, 124, 426–434, 1933
(1) Male, age 58, two years "flatulent dyspepsia" Roentgenologic examination, multiple jejunal diverticula Operation, 40 jejunal diverticula found Recovery
(2) Male, age 59, carcinoma of esophagus, *Roentgenogram also showed diverticula of jejunum* (personal communication of Rutimeyer and Baumann)

[84] Melchior, N D Chir, Bd, 25

[85] Miller, A M Isolated Diverticulum of the Jejunum Am Jour Surg, 2, 116, 1931
Female, age 42, "stomach trouble" three years *Preoperative roentgenologic diagnosis* Excision of diverticulum, recovery

[86] Moore, N Brit Med Jour 1883, 11, 1920
Male, age 40, autopsy, pneumonia (?), three "true" diverticula of jejunum on the mesenteric border

[87] McGrath, B F Intestinal Diverticula Surg, Gynec, and Obstet, 15, 429, 1912
An autopsy specimen of multiple paramesenteric diverticula of small intestine Remainder of article deals with diverticulitis of colon Probably included in Rankin's series

[88] Moreau, J, and Murdoch, J Diverticules du Jejunum Arch franco belges de Chir, 28, 192–202, 1925
Female, age 63, digestive disturbance one year Roentgenologic diagnosis of diverticula Operation, multiple diverticula (12) Resection, death

[89] Moynihan, Berkeley Diverticula of the Alimentary Canal Lancet, 212, 1061–1066, 1927 Brit Med J, 3454, 513–514, 1927
General considerations—no case reports

[90] Neumann (ref Kaspar[70]) Deutsch Ztschr f Chir, 126 (ref Fischer[31])
Female, age 49, lumen of small intestine in one loop narrowed to diameter of a probe by scar tissue, ascribed to chronic inflammation arising from multiple diverticula

[91] Nichols, A G Montreal Med Jour, 28, 387, 1899
Female, age 64, autopsy, 45 jejunal diverticula

[92] Ogloblina, S Multiple Divertikel des Dunndarmes, z sovrem Chir (russ), 5, 1930 Ref Nach zbl Chir, 3, 3169, 1931
Female, age 61, "flatulent dyspepsia" *Preoperative roentgenogram showed two areas suggestive of jejunal diverticula* Operation, numerous jejunal diverticula—bean to pigeon-egg size, resection, recovery (a piece of bone—foreign body—found lying in one diverticulum)

[93] Osler W Ann of Anat and Surg, 4, *202–207*, 1881
Male, age 65, "flatulent dyspepsia" for years Autopsy, 53 diverticula of jejunum

[94] Modesto Dalla Palma Uber multiple Divertikel des Darmes Pathologica, 18, 65, 1926
Female age 73, autopsy, multiple paramesenteric jejunal diverticula

[95] Poncher, H G, and Miles, G Cysts and Diverticula of Intestinal Origin Am Jour Dis Child, 45, 1064, 1933
Excellent bibliography especially on intramesenteric diverticula and cysts of ileum in children (ref McMurrich and Tisdall[50])

[96] Pinninger and Burman (ref Rankin and Martin[98])
Male Operation for obstruction, multiple diverticula on mesenteric border found, died

[97] Rave Klin Wchnschr No 15, 1926

[98] Rankin, F W, and Martin, W J ANNALS OF SURGERY, 100, 1123, 1934
52 cases of diverticula of small bowel, of these *28 were multiple, and 24 were single*
39 jejunal, 11 ileal, two both jejunal and ileal
18 times found at operation, 31 times found at autopsy
38 were in males, 14 in females
Diagnosed roentgenologically three times in 956 roentgenologic examinations
No case was operated upon for symptoms thought to arise from diverticula
Symptoms Thirty had "flatulent dyspepsia", 11 had gallbladder syndromes, four operated on for gastric, duodenal or appendicular disease
Operative procedures two invaginations, two excisions, one side-to-side anastomosis

[99] Regnier, E Multiple Dunndarmdivertikel Fortschr a d Geb d Rontgenstr, 38, 1101–1104, December, 1928
Female, age 58, "indigestion" for seven months *Roentgenologic diagnosis confirmed at operation and autopsy* Three duodenal diverticula and multiple (100 plus) jejunal diverticula

[100] Renaud, Maurice, et Bergeret Deux Diverticules de l'intestin Bull Soc Anat Paris, 18, *220–223*, 1921
Female, age 62, duodenal ulcer Operation, duodenal diverticula, also multiple jejunal diverticula, 4 cm from duodenojejunal angle an especially large diverticulum with a pedicle was excised, contained an enterolith

[101] Reinhardt Multiple Divertikel des Jejunus Ref VIII Tagg Ver Mitteldtsch Chir 1925, Zentralbl Chir, 1, 1091, 1926

(1) Male, age 66	All found	Some associated with
(2) Male, age 84	at	duodenal and gastric
(3) Female, age 86	autopsy	diverticula

[102] Rodenbaugh, Frederick H, and Ingber, S Irving Diverticula of the Small Intestine Am Jour Roentgenol, 18, 62, 1927

[103] Rosedale, R S Jejunal Diverticulosis Surg, Gynec, and Obstet, 61, 223, 1935
(1) Male, age 60, autopsy, carcinoma of bladder, 24 jejunal diverticula, *Taenia saginata* 55 inches long, head attached to ostium of a diverticulum (second case on record, ref Goinard and Courrier,[44] strongyloides intestinalis)
(2) Male, age 73, autopsy, carcinoma of esophagus, 15 jejunal diverticula
(3) Female, age 62, autopsy, arteriosclerosis, 23 jejunal diverticula, 250 colonic diverticula

[103a] Rosedale, R S, and Lawrence, H R Jeunal Diverticulosis Am Jour Surg, 34, 369, 1936
(1) Male, age 53, no history of indigestion Autopsy, diabetic coma, arteriosclerosis, six jejunal diverticula
(2) Female, age 61, autopsy, carcinoma of lung, multiple jejunal and ileal diverticula, also isolated chronic jejunal peridiverticulitis
(3) Female, age 28, autopsy, pulmonary tuberculosis, multiple diverticulosis of duodenum and jejunum
(4) Female, age 68, autopsy, gangrenous appendicitis, multiple diverticula of jejunum (34) and of colon
[104] Rossle, R Munch med Wchnschr, 57, 332, 1910
Female, age 52, multiple (7) jejunal diverticula
[105] Rothschild, N S Diverticula of the Jejunum Annals of Surgery, 82, 250, 1925
Female, age 63, abdominal symptoms for 15 years *Preoperative roentgenologic diagosis of jejunal diverticulum* Operation, healed pyloric ulcer, gallstones, large "true" jejunal diverticulum on antimesenteric border Cholecystectomy, appendicectomy, excision of diverticulum using base for posterior gastro-enterostomy Recovery
[106] Roth Arch d path Anat, 12, 197, 1872
[107] Rider, J R Vet Records 10, 707, 1930
[108] Roevekamp Fortschr a d Geb d Rontgenstrahlen, 36, 298, 1927
Differential roentgenologic diagnosis between niche of lesser curvature and jejunal diverticulum
Female, age 28, *Examined roentgenologically* but not operated upon
[109] Rokitansky Lehrb d Path Anat, 2, 36, 1856
[110] Santoro, Mario Reperto radiologico et Operatorio di diverticolo del digiuno Arch di Radiol, 2, 121–127, 1925
[111] Schmidt, E A, and Guttman, P H Multiple Diverticula of Jejunum and Duodenum Simulating Gastric Diverticula and Complicated by Cholelithiasis Am Jour Roentgenol, 31, 200–203, February, 1934
Female, age 50 Very poor condition following previous cholecystectomy for gallstones, digestive disturbances continued *Roentgenologic examination showed duodenojejunal diverticulosis* Exploratory celiotomy attempted but condition prevented completion Death Autopsy Gallstone impacted in papilla of Vater, three duodenal diverticula, and 59 jejunal diverticula in the upper 50 inches of intestine
[112] Seippel Inaugural Dissertation, 1895, Zurich (ref MacKechnie[79])
Autopsy Multiple "false" jejunal diverticula
[113] Sheppe, W M "False" Diverticula of the Jejunum J A M A, 82, 1118, 1924
Male, age 75, uremia Autopsy, carcinoma of prostate, multiple (54) jejunal diverticula
[114] Siera Bol Soc Chir Chile, 5, No 15
[115] Simons, E J Multiple Diverticula of the Small Intestines Minn Med, 2, 1928
Male, age 57, three previous acute abdominal attacks, now sudden abdominal pain Diagnosis—Perforated duodenal ulcer Celiotomy Findings—Upper jeunum contained innumerable diverticula It was cyanotic and distended, and its mesentery milky white for two feet Bowel stimulated with hot packs Recovery
[116] Somerford, A E Two Cases of Intestinal Disease in Infancy, Congenital Diverticulum of the Jejunum Lancet, 1, 1015, 1930
Male, age seven months, melena for two months Autopsy Sac (resembling small intestine) 9 by 4 by 2 cm, apparently had bled from this sac as the intestinal tract above was light and below the sac it was dark
[117] Spackman, J G Perforation of a Jejunal Diverticulum Annals of Surgery, 84, 778–780, 1926
Male, age 75, sudden onset of severe abdominal pain Operation Free, foul fluid, seven diverticula, two largest acutely injected, one perforated Resection of 15

cm of jejunum Death in 48 hours Autopsy Anastomosis intact, five additional diverticula found None inflamed

[118] Spriggs, E J, and Marxer, O A An Address on Intestinal Diverticula Quar Jour Med, 19, 10, 1925–1926
Diverticula of jejunum observed in seven patients Duodenal diverticula also in one case

[119] Stegmann 300 Divertikel an Jejunum und Ileum Ref 55, Verh deutsch Ges Chir fortschr Rontgenstr 44, 118, 1931
Same case as Gisbertz [40]

[120] Stetten, DeWitt Multiple Diverticula of the Upper Ileum ANNALS OF SURGERY, 73, 241, 1921
Male, age 38 several months' "flatulent dyspepsia", *Preoperative roentgenologic Diagnosis* Diverticulosis of entire colon, two diverticula of jejunum Operation Excision of jejunal diverticula, recovery

[121] Sudsuki Ueber Divertikel am S Romanum (sigmoid) Langenbeck's Arch f klin Chir, 61, 708, 1900
No jejunal cases cited

[122] Swanberg, H, and Montgomery, E B Solitary Diverticulum of the Jejunum Radiol, St Paul, 7, 1926
Female, age 55 *Diagnosed roentgenologically*

[123] Taylor and Lakin Lancet, 1, 495, 1910
Female, age 68 Autopsy Pneumonia, multiple "false" diverticula of jejunum, colonic diverticulosis

[124] Tengwall, E Case of Multiple Diverticula in the Jejunum Acta Chir Scandinav, 68, 162, 1931
Female, age 49, chief complaint bleeding from bowel and vague digestive disturbance *Roentgenologic examination showed many diverticula* Operation Multiple diverticula for 50 cm of jejunum, from hazelnut to hen's egg in size Resection Recovery

[125] Tengwall, Ernst A Case of Diverticula in the Jejunum Acta Chir Scandinav (Stockh), 68, 162–170, 1931
Female, age 49 *Preoperative roentgenologic diagnosis Multiple diverticula* Resection Recovery

[126] Terry, W I, and Mugler, F R Diverticula of the Jejunum Arch Surg, 2, 347, 1921
Female, age 59, operation No 1 for duodenal ulcer—five diverticula of jejunum, two were inverted Operation No 2 for intestinal obstruction by enterolith in a diverticulum

[127] Treves, Frederick Intestinal Obstruction, Jacksonian Prize Essay, p 45, 1883
Speaking of false diverticula Treves considers them "hernial protrusions of the mucous membrane of the bowel through the muscular coat, and hence the common name 'distension diverticula' In structure they are composed simply of mucous membrane and peritoneum They present in their walls no muscular fibers The lining mucous membrane in the smaller pouches is quite normal but in the larger diverticula that membrane becomes atrophied and its glandular structures tend to disappear They may be met with in any part of the bowel, but are somewhat more often found in the large than in the small intestine They have been seen in the duodenum, are comparatively common in the jejunum, and are encountered with still greater frequency in the ileum They may appear in any part of the colon, but are most common in the sigmoid flexure and rectum"

[128] Usland, Olav Diverticula jejuni Norsk Mag Laegevidensk, 91, 101–112, 1930
Female, age 65 *Preoperative roentgenogram shows jejunal diverticulum clearly* Resection

[129] Vaselle Diverticula du jejunum Arch des Mal appar digest etc, 17, 786, 1927

Male, age 62, previous gastro-enterostomy, still had complaints *Roentgenologic examination showed* good emptying of stomach also a *jejunal diverticulum*, which was subsequently excised

[129] Virchow, R Verhandl d Berl Med Gesellsch 21, 116, 1890
Male, age 70 plus Autopsy Multiple "false" jejunal diverticula

[131] Vorhaus, M G Recognition of Some Less Common Diseases Duodenal-Jejunal Diverticula J A M A, 94, 165–169, January 18, 1930
Female, age 35 Roentgenogram suggestive Operation Excision of diverticulum just beyond duodenojejunal angle Recovery

[131] Walmann, H Virchows Arch f path Anat, 14, 202, 1858
Description of museum specimen Typical multiple (37), paramesenteric, jejunal diverticula

[132] Watson, C M Diverticula of Jejunum A Case with Enterolith Causing Intestinal Obstruction Surg, Gynec, and Obstet, 38, 67, 1924
Male, age 73, multiple diverticula with one enterolith causing obstruction Resection, recovery

[133] Weiss, Karl Frankf Ztschr f Path, 37, 96, 1929
Female, age 58, "flatulent dyspepsia", *Roentgenogram suggestive of jejunal diverticula* Autopsy, multiple diverticula for 140 cm

[134] Watanabe (ref Kasparek)
(1) Male, age 40, two diverticula "false", 40 cm from duodenojejunal junction
(2) Female, age 45, single large diverticulum, adherent to another loop, resection, recovery

[135] Walker F E J A M A, 58, 1190, 1912
Female, age 11, diverticula of ileum, size of a fist, many smaller diverticula

[136] Zengerle (ref Kasparek) 1911
Female, three previous abdominal operations, fourth celiotomy, seven diverticula walnut to hazelnut in size, containing enteroliths, discovered

DISCUSSION.—DR J M T FINNEY, JR (Baltimore, Md) was particularly interested in Doctor Gerster's paper, because it so happened that in the last few years he had seen seven cases of duodenal diverticula, six jejunal and two of ileal diverticulitis That seemed so unusual in view of the comparative rarity of this condition, that the literature was looked up quite thoroughly As nearly as could be ascertained diverticula are supposed to occur in a ratio of .2 per cent in the duodenum and 0.2 per cent in the jejunum, while those in the ileum, other than Meckel's, are so rare that no percentage has been given relative to the comparative frequency of their occurrence The paper was additionally interesting because of the report of two or three cases of perforation, a complication which seems to be exceedingly rare in diverticula of the duodenum or jejunum As the speaker indicated, a large percentage of small intestinal diverticula seems to be found accidentally at autopsy, or in the course of operation for something else That had also been his experience Most of the diverticula which cause symptoms are associated with old, healed ulcers or biliary disease, so it is hard to say whether the symptoms are due to the diverticula or to the concomitant lesion

Diverticula are more apt to be demonstrable fluoroscopically, than roentgenographically It is at times possible to miss one at first and pick it up later on One large duodenal diverticulum they missed entirely on first examination In the 16-hour film there was a shadow overlying the transverse colon, which, on repeating the examination, was found to represent a large diverticulum of the third portion of the duodenum A little compression of the duodenum where the third portion crossed the prominence of the vertebral bodies, with a retrograde milking of the barium contents, promoted the filling

of the large diverticulum which had been missed the first time He thought this maneuver useful in demonstrating these duodenal diverticula at times

A second case was of interest because of the multiplicity of the jejunal diverticula which were discovered at operation There must have been 200 to 300 in the first six feet of jejunum That patient was a female, age 75, and was operated upon for an acute intestinal obstruction The diverticula were found incidentally, they had not been diagnosed before operation The obstruction was due to the splenic flexure of the colon having protruded through a defect in the diaphragm After reduction of the hernia, the problem presented itself as to how to close this opening The patient was old and was not in condition to stand a second incision, in addition the operator was working through a low midline incision, under a low spinal anesthesia, which made it impossible to adequately reach or suture the defect In this dilemma he came in contact with a fibrotic spleen, and this was pushed up into the hole as one would cork a bottle A roentgenogram taken at age 81, six years later, shows it still sticking up through the diaphragm The jejunal diverticula were also demonstrable at this examination

Another case is cited because of the universal extent of the diverticulosis The patient was a female, age 77 The roentgenograms showed diverticula extending from the outlet of the stomach to the anus One could see one large diverticulum of the second portion of the duodenum and also two smaller ones of the third portion, scattered down through the jejunum and ileum are many others, small and large The colon showed innumerable sacs, after the main column of barium had been evacuated

Diverticula show quite well roentgenologically if one is careful to look for them, but it is sometimes difficult to demonstrate them in the course of a routine roentgenologic examination unless one is on his guard

DR FRANK S LYNN (Baltimore, Md) —Doctor Gerster's voluminous bibliography indicates that the condition of diverticula of the small bowel is not as rare as one would gather from a cursory review of the literature

Case Report—A white female, single, age 58, was admitted to the University Hospital September 15, 1937, with a diagnosis of intestinal obstruction In 1911, she had had a gallbladder operation and, in 1924, was operated upon for uterine fibroids The present attack came on 48 hours before admission Various efforts were made to relieve the obstruction, both at home and after admission to the hospital, without success Under spinal anesthesia a celiotomy was performed, and on searching for the site of the obstruction, a number of pouches along the mesenteric border of the jejunum were found One intestinal segment of about 30 cm contained from 25 to 30 diverticula varying in size from 0 5 to 4 cm in diameter The obstruction was caused by adhesions between the ileum and large bowel The diverticula showed no evidence of inflammation or infection nor any tendency to perforate, and were left undisturbed The obstruction was released, and the abdomen closed The convalescence was uneventful, and the patient was discharged three weeks postoperative

At the end of a month she was called back for roentgenologic examination The third slide made from these examinations substantiates Doctor Gerster's statement that these shadows do not, at times, show in the roentgenogram, notwithstanding the fact that their presence had been demonstrated at celiotomy One film, however, showed three diverticula The procedure suggested by Doctor Finney, Jr, of pressing on the duodenum in order to demonstrate more clearly the diverticula of this portion of the bowel, is certainly well worth adopting in making roentgenologic examinations

DR J M T FINNEY, SR (Baltimore Md) —Every surgeon must have been impressed with the fact that the problems of the abdominal surgeon,

instead of becoming less as time goes on, are rather being continually added to It is only within comparatively recent years that the question of diverticulitis has engaged serious consideration Now, however, in addition to appendicitis, cholecystitis, colitis and tumors of various kinds, one must seriously consider the question of diverticulitis in making his differential diagnosis in an acute abdominal condition The clinical picture of diverticulitis is not infrequently so obscured by other complicating conditions that the diagnosis is rendered most difficult I have found that where a diagnosis in an obscure abdominal condition cannot readily be made, the possibility of diverticulitis should always be borne in mind

THE COMPLICATING EFFECTS OF DIVERTICULITIS OF THE COLON UPON ABDOMINAL SURGERY AND ESPECIALLY UPON SURGERY OF THE LARGE BOWEL

VERNON C DAVID, M D , AND R KENNEDY GILCHRIST, M D
CHICAGO ILL

IF IT were not for the complications occurring in diverticula of the colon their occurrence would be of but academic interest These complications, the result of infection in poorly drained, narrow-necked diverticular sacs, have been rather commonly observed and well described They really represent the same happenings that occur on the right side of the colon in appendicitis, except that, in general, the infectious process in diverticulitis is more chronic Adhesions of the sigmoid appendices epiploicae containing the diverticula to the pelvic peritoneum or surrounding viscera and scar tissue narrowing of the sigmoid, fistula formation between the sigmoid and bladder or other viscera, are more common than acute perforative abscess formation so commonly observed in appendicitis and but only occasionally encountered in diverticulitis

In any major intra-abdominal surgery the presence of an infectious process in the field of operation is a hazard This is well exemplified in surgery of the left half of the colon in the presence of diverticulitis One of the most annoying complications in a one-stage abdominoperineal resection of the rectum is to find the sigmoid loop firmly adherent to the peritoneum of the small pelvis and bladder as a result of diverticulitis of the sigmoid This condition is in contrast to the usual congenital, pliable attachments of the sigmoid to the lateral parietal peritoneum The implications of this inflammatory attachment of the sigmoid are first, that when the sigmoid is finally freed from its attachments there is little pelvic peritoneum of suitable quality left to effect the peritonization of the pelvic floor after placing the carcinomatous bowel beneath it Beyond consumption of time and technical difficulties this, however, can usually be safely accomplished

The second complication from the effects of local peritonitis due to diverticulitis near a carcinoma of the sigmoid or upper rectum is the adhesion to, or perforation into, neighboring organs As the sigmoid most commonly becomes adherent to the bladder under these conditions, real difficulty is presented in deciding whether the carcinoma is invading the bladder or whether the mass between the bowel and bladder is carcinoma plus diverticulitis We have had several such decisions to make and a brief résumé of one case may be of interest

Case Report—P B , male, age 63, a diabetic, was admitted to the Hospital, June 2, 1936, with a typical history and findings of beginning obstruction of rectosigmoid by a carcinoma Due to urinary frequency a cystoscopy was performed which showed bullous edema of the dome of the bladder

Operation—A large growth, the size of an adult fist, was found involving the recto-sigmoid and the fundus and posterior wall of the bladder, extending from the dome almost to the trigone Many diverticula were present above the growth in the sigmoid An obstruction-resection of the sigmoid and about one-third of the posterior aspect of the bladder was carried out The patient made a good recovery except for an abdominal wall infection which was due to the perforation of a diverticulum into the abdominal wall

Pathologic Examination revealed, in addition to the carcinomatous ulcer of the sigmoid and apart from it, a perforation on the posterolateral aspect of the bowel A probe could be passed through this perforation to the fat covering the wall of the bladder This perforation contained pus Histologic examination of this area showed chronic granulation tissue but no carcinoma It appears likely that the adherence of the bowel to the bladder was as much from diverticulitis as from carcinoma

The third complication is of more importance and concerns itself with the development of pelvic peritonitis or a fatal general peritonitis as a result of inadvertently cutting into an area of active infection around an inflamed diverticulum or of even cutting into a diverticulum in the process of mobilizing the sigmoid preparatory to resection While it is difficult to prove beyond doubt, we feel much inclined to attribute the death of two obese patients to this cause Both of them had marked inflammatory adhesions between the sigmoid and parietal peritoneum of the small pelvis In neither patient was there found, at autopsy, any other cause for the development of the peritonitis Our assumption in regard to this origin of peritonitis is somewhat supported by the experience in two other male patients where a small fecal fistula developed in the posterior wound, following a one-stage abdomino-perineal resection of the rectum These fistulae persisted for many months after the operation and in one patient occasionally discharged feces a year after the operation

That unsuspected diverticula of the sigmoid may be easily opened when ligating appendices epiploicae, is well known This procedure is avoided, for that reason, in the bowel which is to remain intra-abdominal or even buried in the abdominal wall, and is employed only to remove the excess fat in the portion of the colostomized bowel above the skin level In spite of our knowledge of these facts, coupled with an effort to handle the colon as gently as possible, we have had at least five serious abdominal wall infections around terminal colostomies which were due to perforation of diverticula in the portion of the bowel passing through the abdominal wall In these cases the abscess contained foul pus and gas and the openings of the perforated diverticula were seen It is not uncommon to see thin-walled diverticular sacs in the sigmoid, and as we know that the mucosa of the bowel covered with fat is the only resistance to perforation, it is not surprising that perforation should take place

In our opinion the most compelling force to accomplish the perforation is an increase of intra-intestinal pressure and this is accomplished, in an end colostomy, by keeping the bowel closed by ligature or clamps for one to three days, in which event an increasing distention of the bowel takes place It has been our practice to open the colostomy within 24 hours after its forma-

tion, to insert a catheter into the bowel and gently irrigate it, thus relieving the intra-intestinal pressure Of late, however, we have removed the ligature closing the proximal colon in several cases at the close of the operation This is made safe by surrounding the bowel at the operation by crisscross layers of flat sponges well covered with zinc oxide ointment The peritoneum of the bowel and the gauze adhere to each other and make an immediate watertight protection of the abdominal wall from the bowel These dressings are left in place for at least a week as they become firmly attached to the peritoneum of the bowel We are of the opinion that the danger of early opening of the bowel after colostomy is overemphasized and that, on the contrary, early opening is indicated, not only to relieve the discomfort of the patient from the distention but also to decrease the danger of perforation of diverticula in the distended bowel Perforations of diverticula into the abdominal wall have implications other than the necessity of opening an incision and draining an abscess Persistent sinuses leading to the site of perforation with recurrent infection are exceedingly annoying, but of more serious import, we believe, is an increase in the number of instances of thrombophlebitis occurring in these patients

Another serious situation occasionally appearing coincidentally with the development of a deep abdominal wall infection is a reflex paralytic ileus, in which the patient becomes distended and vomits but has no general abdominal pain On opening the abscess the paralytic ileus quickly subsides We have observed this type of paralytic ileus due to deep abdominal wall infection in other types of bowel resection and after stomach resection

If perforation of sigmoid diverticula were concerned only with abdominal wall infection, its seriousness would not be great but the danger of perforation of diverticula intra-abdominally in acute overdistension of the bowel must be considered That acute distension of the colon is a predisposing factor to perforation of a diverticulum is instanced by a patient who had had a perforation of a sigmoid diverticulum during the administration of a large barium enema The brief case reports of two patients with fatal peritonitis following perforation of diverticula in a bowel distended from obstruction are herewith cited which illustrate this complication

Case 1—N W, female, married, age 48, was admitted December 15, 1936, with the history of six months of diarrhea Examination showed a carcinoma at the rectosigmoid encircling the rectum The abdomen had been distended Six days before examination a chill was followed by a temperature of 103° F, white blood cells, 25,000, tenderness and rigidity in left lower quadrant of the abdomen, and distension Operation revealed a spreading peritonitis from a perforated diverticulum in the sigmoid loop Other indurated diverticula of the colon were palpated Death in five days

This case illustrates the danger of obstruction of the bowel where the colon contains thin-walled diverticula

Case 2—Patient of Dr Gatewood T L H, female, married, age 77, was admitted July 1, 1936, with the history of bloody diarrhea for five months An encircling carcinoma was found 14 cm from the anus Operation revealed an inoperable

carcinoma because of local attachments of the tumor The bowel was divided and the proximal ligated loop brought out for an end colostomy The colostomy was opened *two and one-half days after the operation* Gas and feces escaped, the nausea, distension and temperature continued, white blood cells, 16,000 A few days later, a mass was present in the abdomen medial to the colostomy Patient died Autopsy showed generalized peritonitis with feces in the abdomen Twelve cm proximal to the colostomy, an opening 1 cm in diameter was found in the colon One inch distal to the perforation was a diverticulum which was surrounded by granulation tissue into which the diverticulum had almost perforated In that portion of the sigmoid drawn through the abdominal wall there were three diverticula near an abscess in the abdominal wall

This patient had had diverticulosis—perhaps diverticulitis—for years Some factor had caused perforation with resultant death from peritonitis We suggest that the increased intra-intestinal pressure from an obstructing carcinoma, coupled with 48 hours of obstruction at the time of operation, was a factor to be seriously considered

The last phase of infection of and around diverticula of the colon which may complicate operative procedures, or occur as the sole lesion, concerns itself with pylephlebitis arising in the veins around an area of diverticulitis This condition is admittedly rare or unrecognized when originating from this source, when compared to its rather easy recognition when it occurs as a complication of suppurative appendicitis Very few references in the literature could be found pertaining to this source of pylephlebitis H Siegmund[1] refers to the possibility of septic thrombophlebitis originating from an infected diverticulum but mentions no case he has observed Erich Lewin[2] reports the examination of a patient with liver abscesses in whom the autopsy revealed the origin of the septic thrombophlebitis to be from the veins around an infected diverticulum Brief reports of two cases of pylephlebitis arising from infected thrombi in the veins and an infected diverticulum are appended

Case 1—A doctor, age 60, was seen in consultation because of a succession of chills, fever and sweats which had been occurring for about three weeks The symptoms usually occurred every other day and during the interval he felt well Leukocyte count, 15,000 His general physical condition was good There was no jaundice, neither his spleen nor his liver was enlarged The only history of significance concerned several mild attacks of lower, left-sided abdominal pain associated with soreness, which had been diagnosed as diverticulitis At the time of examination he was slightly tender and had some slight muscle resistance over this area A diagnosis of septic thrombophlebitis was made with possible origin about an infected diverticulum Two weeks later jaundice occurred His liver and bile ducts were explored without any significant findings The disease continued with increasing severity for several weeks, when death ensued A postmortem examination revealed an inflamed diverticulum of the sigmoid and a vein running from it which contained a soft, infected thrombus The liver contained countless small abscesses There were no other significant findings

Case 2—A doctor, age 69, rather obese and pale, complained of having had repeated attacks of discomfort in the abdomen, accompanied by the production of large amounts of gas Four to six weeks later, he developed jaundice, chills, fever and sweats and was hospitalized by Dr LeRoy Sloan, and a general examination was carefully conducted Multiple diverticula of the sigmoid and transverse colon were found The gallbladder did not fill but no stone shadows were seen He was again examined at the termination of a chill, when his temperature was high and he was very apathetic

His abdomen was soft and was not tender on pressure The liver was slightly enlarged and had a sharp edge He was markedly jaundiced His urine was negative except for bile His leukocyte count was increased Death occurred a few days later The postmortem examination revealed an infected diverticulum of the sigmoid, an infected, thrombosed vein leading from it and multiple abscesses of the liver

While neither of these cases occurred as a complication of abdominal surgery, they indicate a possible source for septic pylephlebitis, and emphasize the insidious and sometimes unsuspected rôle that diverticulitis plays in the production of serious lesions apart from their local manifestations

CONCLUSIONS

Diverticulitis is a source of some of the serious complications encountered in surgery of the left half of the colon and presents a suggestion of the importance of increased intra-intestinal pressure as an etiologic factor causing the perforation of sigmoid diverticula

The early opening of end colostomies is advocated

REFERENCES

[1] Siegmund, H Ref Henke, and Lubarsch 4, No 3, 233, 1929
[2] Lewin, Erich Mettheil a d Grenggebret de Med und Chir, 42, 517–531

THE SURGICAL TREATMENT OF INTRACTABLE, CHRONIC ULCERATIVE COLITIS

HENRY W CAVE, M D
NEW YORK, N Y

THE permanent cure of extensive, intractable chronic ulcerative colitis demands the complete removal of the diseased bowel Less radical measures have proven inadequate Too many patients suffering from this disease have been lost by being temporarily relieved following medical treatment, wandering from hospital to hospital, from one physician to another and gradually but steadily losing ground

Medical management—which has consisted principally of rest in bed, high caloric, high vitamin, low residue diet, irrigations, the elimination of focal infections, the use of vaccine and serums in the intractable cases—has, for the most part, been ineffectual It seems unreasonable to assume that a disease which has caused such extensive infiltration and marked scar tissue production in the deeper layers of the colonic wall could be reached by any known medical procedure We are not convinced that the disease is due to a specific organism, but that a variety of different organisms play a rôle as etiologic agents Many of the very severe cases are complicated by mixed deficiency states They are often accompanied by characteristic changes in the small bowel, demonstrable roentgenologically, which are identical with those observed in sprue Intestinal allergy may play also an important rôle in the exacerbations which are notable in this disorder I believe, although it may be difficult to prove statistically, that the percentage of lasting or permanent cures has been exceedingly small, therefore, colectomy, partial or total, is a measure of necessity

Indications for Surgery—Apart from the acute emergencies of impending perforation or massive repeated hemorrhage, surgical treatment should be withheld until two factors have been evaluated the clinical response to conservative treatment, and the degree and extent of permanent damage to the colon This frequently entails study of the patient over a relatively prolonged period Disturbances of fundamental physiology must be corrected The influence of diet must be determined by repeated and accurate trial Deficiency states must be recognized and effectively combated And if pathogenic bacteria are recovered on cultures, autogenous vaccine should be used Failure to achieve definite clinical improvement by these measures, persistence and progression of the lesions as seen at proctoscopy, and roentgenologic evidence of progressive fibrosis of the colon with pseudopolypoid degeneration of the mucosa, constitute the elective indications for surgery

Operative Procedures—Three operative procedures, frequently performed, have no place in the management of intractable chronic ulcerative colitis Appendicostomy, cecostomy and colostomy are based upon false

premises, *i e*, the assumption that medicated irrigations will eliminate infection and therefore accomplish cure In our experience, these procedures are not curative or even palliative, and they complicate subsequent radical surgery when and if this becomes necessary

Partial colectomy is justified in well selected cases, where the disease is definitely limited to one portion of the colon, the Mikulicz type of resection is ideal and relatively safe If the rectum and lower sigmoid are alone involved, a combined abdominoperineal resection in two stages will minimize the complication of peritonitis

Ileostomy in the past has been employed as a curative measure, in the light of our present knowledge this procedure as such has been discarded By diverting the fecal current sufficiently early in the course of the disease, lives have been saved A striking clinical improvement is seen, yet the toxemia, although temporarily diminished, persists and the patient is not cured until the infected colon is removed Ileostomy is an easily performed surgical maneuver, yet attended with considerable danger, the mortality has been high due to rapid and excessive loss of fluids, chlorides, to peritonitis, and to the fact that though a simple procedure it has too often been postponed too long

Cattell[1] has a 22 per cent mortality following ileostomy, in a small series of cases operated upon at the Roosevelt Hospital, the mortality was 40 per cent Kunath[2] cites an 83 per cent mortality following ileostomy performed in 12 cases As a preliminary step to colectomy it is essential

Colostomy is of value in diverting the fecal stream, particularly where only the lower sigmoid and rectum are involved, and in many instances assuring the patient of less inconvenience than ileostomy

Ileosigmoidostomy, preferably end-to-side, as a first-stage measure prior to subtotal colectomy, has been successfully utilized, however, there is grave danger that by such a measure the disease process may extend into an otherwise healthy rectum I wish to emphasize the fact that it is only in an exceedingly small group (less than 10 per cent) of segmental colitis that ileosigmoidostomy is ever justified It is important to state clearly that this procedure is unwarranted if the descending colon and rectum show the slightest involvement

Probably one of the first subtotal colectomies performed in this country for chronic ulcerative colitis was in a patient of Howard Lilienthal's,[3] in 1900 His patient, a girl, age 25, had been operated upon previously elsewhere, a left-sided colostomy having been performed Lilienthal closed the colostomy and anastomosed, end-to-end, the terminal ileum and the lower sigmoid, later resecting from left to right the entire colon This patient made a satisfactory recovery and is living to-day Since then, numerous surgeons have in a few instances found it necesary to remove the colon for this disease No large series of colectomies have been reported in this country except six cases reported by Rankin,[4] in 1931, five others,[5] in 1935—at the Lahey Clinic where

Cattell[6] has performed 16 total and six partial colectomies, and at the Mayo Clinic,[7] where 40 colectomized patients were recently studied

Our awakened interest in the surgical treatment by radical measures began in February, 1936, prior to this time, cecostomies, appendicostomies and ileostomies, as curative procedures, had been carried out in a fair number of instances Our experience has not been a large one—our series is too small (six) and not sufficient time has elapsed to report on late-results—yet we are convinced that with adequate preoperative preparation and adhering to certain technical principles the entire diseased large intestine can be removed without great risk

Preoperative Preparation—When radical surgery is indicated, preoperative measures should be carefully and thoroughly instituted Repeated small transfusions, twice daily of 1,000 cc of intravenous 5 per cent glucose in saline, occasional colonic irrigations with warm saline solution, low or non-residue diet, 72 hours prior to operation lead and opium pills which tend to diminish the size of the bowel making it technically easier especially at the second stage, when practically the entire bowel is removed

Anesthesia—In our hands avertin and cyclopropane has proven a safe combination and ensures satisfactory relaxation We have made it a practice that immediately the cyclopropane was started the avertin should be withdrawn from the rectum However, we are not averse to the spinal anesthesia with nupercaine (Ciba) 1 to 1,500 (Howard-Jones dilution)

Operative Technic—Three separate stages (occasionally four) are usually required to perform a total colectomy

First Stage—Transverse permanent ileostomy six inches from ileocecal valve through a right McBurney incision, thus the small intestinal contents are brought out on the anterior abdominal wall, the distal end of the divided ileum is dropped back, if stricture of the colon exists, it is preferable to establish a mucous fistula of the distal divided end, transfusion immediately at end of operation

Second Stage—At least five to eight weeks and even longer should elapse between the first and second stages to insure reestablishment of water balance, gain in weight and general improvement, a long left paramedian incision The omentum is detached from the transverse colon, thus simplifying the removal of this portion of the bowel as well as preserving the omentum to cover in raw areas and so lessen the possibility of intestinal obstruction The small segment of terminal ileum, the ascending, transverse, descending, and upper sigmoid colon are removed, leaving only approximately four inches of lower sigmoid above the peritoneal reflection Meticulous care should be exercised in keeping the intestines completely covered with warm moist pads, with peritonization of the raw surface after removal of the ascending portion, before proceeding with the resection of the transverse portion, and so on down In dividing the transverse mesocolon a sudden fall in blood pressure may occur, if this happens we have found it advantageous to transfuse In sever-

ing the lower sigmoid a guarded rubber clamp, as advised by Rankin,[8] has been applied to avoid soiling from cutting through, as sometimes happens with a heavier crushing clamp The stump is sutured in several layers with fine chromic catgut and reinforced with two rows of mattress sutures of fine silk At times it may prove safer to suture the open lower sigmoid stump to the anterior abdominal wall Needless to say, careful hemostasis is essential A Levine tube in the stomach prevents postoperative gastric dilatation, sufficient sedation keeps a patient comfortable, and large quantities (3,500 to 5,000 cc) of intravenous fluids will lessen the degree of postoperative reaction

Third Stage—Combined abdominoperineal resection in one stage two to six months after the second stage to permit of satisfactory rehabilitation More rapid convalescence ensues if the perineal wound is sutured in layers, leaving a small rubber drainage tube at the upper angle near the tip of the coccyx, in order that the cavity may be irrigated daily with 1 to 1,000 iodine solution to promote healing Transfusion immediately at end of the operation

In a few selected cases a two-stage maneuver possibly meets requirements, this naturally is predicated upon the proven presence of a normal sigmoid and rectum Ileosigmoidostomy, end-to-side, at the first stage, subtotal colectomy comprising the second Where the left colon and rectum alone are diseased, a two-stage procedure is all that is necessary, first transverse colostomy with removal down to lower sigmoid, second-stage combined abdominoperineal resection

Occasionally, in the particularly debilitated bad risk patient, four stages are safer , the second stage would then consist of removal of the ascending and transverse colon, leaving the splenic flexure, descending and upper sigmoid colon for the third procedure

Since February, 1936, we have performed six colectomies Two total colectomized patients have been entirely completed, one still has remaining the lower sigmoid and rectum, two others have had ileosigmoidostomies and subtotal colectomies and one had had a partial colectomy of the descending colon All six were females, all had been ill for three years or more, one 15 years All complained of diarrhea, with blood, mucus and pus in the stools, loss of weight and of being chronically ill There have been no fatalities All wounds have healed per primam These patients all had remarkably smooth postoperative convalescence, due, I believe, to careful and sufficiently prolonged preoperative preparation and to self-immunization from the presence of a diseased colon for a long period of time In all there has been an amazing gain in weight after the preliminary ileostomy as well as after the more radical colectomy With the patients who have had the complete operation of total colectomy, it has been found that the ileal stoma is discharging less frequently with fairly well formed movements, in other words, taking on the characteristic of a rectum, only, however, after the third stage had been carried out with removal of lower sigmoid and rectum Cattell had previously observed this compensatory phenomenon

RESUME OF THE CASE HISTORIES OF SIX COLECTOMIZED PATIENTS

Case 1—No 17, 960 N L G, female, age 54, was admitted to Roosevelt Hospital, February 1, 1936, with the history of having been taken ill in Egypt, in 1929, with severe attacks of dysentery, not associated with fever Since that time, the diarrhea has been chronic and constant During the first two or three years, there were periods in which blood and mucus were present in the stools She has been treated with emetin and yatren A diagnosis of chronic ulcerative colitis was made in 1935

Treatment has consisted of a variety of diets, small doses of cascara, belladonna, and sedatives at night She is sensitized to milk, cod liver oil, and haliver oil Her weight four or five years ago was 122 lbs Present weight, 77 lbs

Physical Examination showed a much emaciated, middle aged woman No atrophy or soreness of the tongue Heart is normal in size and position, sounds of good quality Lungs are clear No enlargement of lymph nodes Abdomen is distended There is marked visible peristalsis No enlargement of liver, spleen, or kidneys There was intermittently present, in the right lower quadrant of the abdomen, a firm, sausage-like mass, some 3 cm in length, easily movable, and slightly tender Sigmoidoscopic examination, up to 25 cm, showed an entirely normal mucous membrane, without any evidence of pus or presence of an inflammatory process

Laboratory Data—Cultures were negative for bacteria and amoebae, agglutination, negative Roentgenologic examination of stomach, negative Forward progress of the barium meal was accelerated until the sixth-hour-fill was reached, at this point, a delay occurred Immediately upon entering the cecum, the barium passed forward rapidly There was a narrowed and apparently stiffened area of small intestine seen arching up to the left, joining the mesial border of the cecum This was interpreted as indicating a thickened and stiffened terminal ileum corresponding to the mass which was palpable

This patient seemed to present a picture typical of partial obstruction Preoperative diagnosis Chronic ileitis, partial obstruction

Operation—March 1, 1936 Long right rectus incision Findings revealed a small, thickened, and inflamed terminal ileum, the pathology picture affected the cecum, ascending, and transverse colon almost down to the midportion of the descending colon The wall was thickened There was considerable subperitoneal scarring Ileocolostomy, side-to-side, transfusion given at the close of the operation Exceedingly smooth and satisfactory postoperative course

Second Operation—April 13, 1936 Subtotal colectomy A long left paramedian incision The remaining terminal ileum and the entire large bowel were removed down to approximately two inches above the ileosigmoidostomy anastomosis

This patient had a very smooth postoperative course, and made an uneventful recovery The pathologic report was chronic colitis, nonspecific, polyposis of colon

Follow-Up—This patient has been seen every two or three months She has gained 26 lbs in weight Has two bowel movements a day, one in the morning and another in the afternoon Last follow-up note was in July, 1936 She was perfectly well and was maintaining her weight

Case 2—No A 362,522 L P, female, age 53, was admitted to Roosevelt Hospital, April 22, 1936, with a history of having been taken ill 15 years ago, in 1921, with a siege of diarrhea with five to eight stools a day consisting of blood and mucus, accompanied by severe abdominal pain and cramps Medical management gave some relief She had had similar attacks in 1931, 1933, and two and one-half months ago Her condition had become progressively worse, with a 15 lb loss of weight

Physical Examination showed a chronically ill, nervous woman Aside from a blowing systolic murmur at the apex, the examination was essentially negative except for the local condition Tongue was smooth and atrophic Abdomen moderately distended, tympanitic, and exhibited generalized tenderness to palpation Proctoscopic examination revealed an acutely inflamed mucosa which bled There were patches of

purulent exudate, but no definite ulceration up to 12 cm , not much narrowing or stiffening of the wall She ran a temperature ranging between 100° and 102° F

Laboratory Data—Red blood cells, 4,500,000, hemoglobin, 84 per cent, white blood cells, 4,900, with 55 per cent polymorphonuclears Gastric analysis showed low hydrochloric acid content Stools negative for dysentery Bacilli, no amoebae were discovered Roentgenologic examination showed extensive involvement of the entire colon, interpreted as a chronic ulcerative colitis

The patient was treated medically for four weeks with bismuth, infusions of normal saline and glucose, emetine, liver extract, and belladonna

Operation—May 2, 1936 A terminal transverse ileostomy was performed She made an uneventful postoperative recovery and was discharged for rehabilitation at home prior to a proposed colectomy

Second Operation—September 23, 1936 (about five months after the terminal ileostomy) The entire colon was removed, leaving only about five inches above the peritoneal reflection in the pelvis The patient was transfused during the operation

Pathologic Examination—Eight cm of terminal ileum and 52 cm of colon, which had a diameter of 6 cm in the cecum and 2 5 cm in the sigmoid, had been resected The wall of the colon was thickened throughout and had a fibrous texture on section The mucosa of the colon had a varying amount of polypoid regeneration springing from the denuded surface The polypi were 2 to 4 Mm in length, with the intervening tissue fibrous, gray in appearance, and presented cracks which penetrated into the muscular coat The widest ulceration was in the transverse colon, and the greatest number of polypi in the cecum

Sigmoidoscopically, the mucosa was deeply ulcerated, with fibrosis extending down into the submucosa and between the muscle fibers There were some areas of regenerating mucosa The ulcerated zones were infiltrated by lymphocytes, polymorphonuclear leukocytes, and eosinophils which extended into the granulation tissue arising within the muscularis

Follow-Up—This patient has been seen every two or three weeks since her operation She has gained about 15 lbs in weight Her ileostomy is discharging a watery secretion almost continuously, and she has some blood and mucus discharged from the rectum and rectosigmoid that was left Before this patient is completely cured, I believe a removal of the lower sigmoid and rectum will be necessary

April 12, 1937—Since discharge from the Hospital, patient has gained 29 lbs in weight The ileostomy has an almost constant drainage, with occasional blood and mucus by rectum Proctoscopic examination reveals an acutely inflamed, granular, bleeding mucous membrane

Third Operation—May 28, 1937 Combined abdominoperineal resection of remaining sigmoid and rectum Five hundred cc of blood given by direct method immediately following operative procedure The patient withstood the operation well and was out of bed on the eighteenth day postoperatively

Pathologic Examination—The walls of sigmoid and rectum are indurated and thickened The mucosa is granular, red and moderately eroded Microscopic examination reveals a typical picture of ulcerative colitis Mucosa heavily infiltrated by lymphoid tissue Many small zones of erosion and masses of lymphocytes and fibrosis of wall Patient discharged July 18, 1937, with ileostomy functioning satisfactorily and her general condition is good

November 1, 1937—Patient was seen in the Chronic Ulcerative Colitis Clinic and reports that the drainage from the ileostomy was becoming less, and there was a suggestion of formed bowel movements

Case 3—No 365,411 G C, female, age 36, was admitted to Roosevelt Hospital, October 17, 1936, with the history that in 1924, 13 years ago, her present illness began with diarrhea, six to ten stools a day without blood or mucus These attacks continued off and on until 1934 when she first noticed mucus and blood in the stools

She soon lost weight, became weak and easily fatigued At this time, she was having somewhere between 15 and 20 stools a day She had tried many diets without benefit In February, 1936, she was having from 20 to 30 evacuations a day, with much distension, and a great deal of abdominal pain, rectal bleeding in large amounts, and distressing anorexia

Physical Examination showed a thin, undernourished, emaciated woman Skin, dry Abdomen spastic and exhibited generalized tenderness, most marked in the lower portion There was avitaminosis, as evidenced by the acute sprue of the tongue and the massive rectal hemorrhages Sigmoidoscopy up to 22 cm revealed a normal rectum and rectosigmoid At the upper limit, two small polypi were visualized There was no evidence of scarring or preexistent active inflammation

Laboratory Data—Barium enema showed extensive disease of the colon, involving the entire area proximal to the rectum, with narrowing, shortening, and pseudopolypoid degeneration Gastric analysis showed an achlorhydria Red blood cells, 1,800,000, white blood cells, 12,800 Septic temperature between 101° and 104° F for 37 days Blood cultures, negative

Dr Thomas T Mackie outlined a treatment consisting of transfusions, large amounts of intravenous fluids, and massive doses of vitamin C in order to check the hemorrhage and elevate the red blood cells She was found to be definitely sensitized to milk and wheat, and probably to other foods as well, all of which caused pain, increased the number of stools and the bleeding, as well as the nausea Her diet, therefore, was limited to foods which she could tolerate, *i e*, lamb, mutton, beef, spinach, tomatoes, beets, beet tops, squash, rice, rye, barley, oatmeal Liver extracts were given in large doses On account of the almost complete anorexia and emotional status, she was given forced, tube feedings containing a high vitamin content

After several weeks under this medical regimen, her appetite returned, temperature became normal, bowel movements diminished, and the red blood cells elevated up to 4,060,000, with 76 per cent hemoglobin She remained at home for a six-month period, and reentered Roosevelt Hospital October 17, 1936

Operation—An end-to-side ileosigmoidostomy was performed, following which a transfusion was given The operative procedure was decided upon after several sigmoidoscopies, the rectum having been found devoid of any signs of involvement Following the side-tracking operation the number of her bowel movements were reduced to one to three daily

Second Operation—November 23, 1936 (five weeks later) A colectomy was performed, extending down to the anastomosis of the ileum and sigmoid The sigmoid seemed to be involved this far down and a clamp guarded with rubber tubing was used to divide the sigmoid above the anastomosis in order to prevent cutting through and soiling, which no doubt a Payr clamp would have done A stab wound was made to the left through an intramuscular incision and two Penrose drains inserted down to the stump of the rectosigmoid (the stump was friable and probably involved in the ulcerative process) It was thought at this time that a permanent ileostomy with removal of the lower rectum and rectosigmoid segment might have to be carried out A transfusion was given to this patient during the operation

The patient had a very slight reaction following the operation, the temperature rising to 100° F for a few days only Convalescence was otherwise uneventful and she began to gain in weight immediately She was discharged 31 days after the colectomy, and was having but one to two bowel movements daily

Pathologic Examination—Seventy-six cm of colon and 10 cm of terminal ileum had been resected The ileum appeared to be normal The serosal surface of the colon was smooth and glistening, except in the distal portion of the transverse colon where it was roughened The diameter was narrowed in areas The mucosal markings were practically wiped out There were numerous deep ulcerated areas with a hemorrhagic base and surrounding mucosal edema Microscopically, the mucosa was eroded in some

areas, with a flattening or thickening in others There was marked inflammatory reaction, mostly chronic in type, throughout the wall of the colon

Follow-Up—This patient has been seen at least once a week since discharge from the Hospital Last seen November 5, 1937, at which time she had gained 21 lbs in weight since her operation She has three or four bowel movements a day Her condition is generally very satisfactory

Case 4—No 366,461 M F, female, age 45, was admitted to Roosevelt Hospital December 28, 1936, with a history of having had diarrhea with mucus and a slight amount of pus, and varying amounts of blood in the stools intermittently for seven to nine years Stools vary from one to ten daily, some tenesmus at times Menstrual periods and her frequent emotional upsets increase the diarrhea and discomfort She is weak and practically bedridden

Physical Examination showed a thin, undernourished, anemic woman, who appeared chronically ill No masses or tenderness in the abdomen Tongue was sore and showed some atrophy Sigmoidoscopy revealed multiple small ulcers in the rectum which bled easily, also a definite tendency to narrowing and constriction

Laboratory Data—Hemoglobin, 32 per cent, red blood cells, 3,300,000, white blood cells, 11,200 Gastric analysis showed an achlorhydria and very low total acidity Blood in stools Agglutination for typhoid and dysentery Bacilli negative in 1 80 dilution Roentgenologic examination after a barium enema showed the whole colon tubular, with haustral markings absent and evidence of some ulceration There were some polypoid changes in the descending colon *Diagnosis*—Extensive chronic ulcerative colitis

Her temperature ranged from 98° to 101° and 102° F daily She was given a direct blood transfusion Her therapy consisted of a soft diet with high protein and low carbohydrate, iron, kaolin, dilute hydrochloric acid, and various vitamin preparations Between December 28, 1936, and March 10, 1937, she was given four direct transfusions of 500 cc each which raised her hemoglobin to 63 per cent and red blood cells to 4,320,000 Some improvement was noted, but she still suffered with diarrhea, blood, and mucus being present

Operation—March 13, 1937 Permanent transverse ileostomy She received a direct blood transfusion immediately postoperatively Except for some skin ulceration around the ileostomy stoma, she had a smooth convalescence, and was discharged April 18, 1937, 36 days postoperative, with the ileostomy functioning satisfactorily

The patient returned to the hospital June 15, 1937 Since discharge, she has gained 12 lbs in weight, appetite good Ileostomy is functioning well, although she has no control over it She continued to have blood and mucus by rectum Hemoglobin, 55 per cent, red blood cells, 3,360,000 She was given one blood transfusion, vitamins, and iron preparations

Second Operation—July 14, 1937 Subtotal colectomy, leaving probably five inches of the lower sigmoid Direct transfusion immediately after operation Temperature fell to normal on the fourth postoperative day Her convalescence was remarkably smooth, and she was out of bed on the eighteenth postoperative day

Pathologic Examination—There was a considerable hyperplasia of the lymphoid tissue, superficial erosion of the mucosa, diffuse inflammatory infiltration, and fibrosis in the deep coats, and the blood vessels are reduplicated The transverse and descending colon showed the same changes, but not in greatly exaggerated form There still remain considerable areas in which the mucous membrane is preserved which has repaired itself Between these zones, there are ulcerations, the centers of which are occupied by polymorphonuclear leukocytes and the edges infiltrated by mononuclear leukocytes, lymphocytes, and fibroblasts The submucosa is densely fibrous and bands of exudate and fibrosis extend throughout the muscular coat and into the serosa There are superficial zones of granulation tissue, heavily infiltrated by mononuclear leukocytes Sections of the lymph nodes from the tissue of the colon show a moderate hyperplasia of the germinal centers

Interval Examination—November 4, 1937 Since her discharge in August, 1937, the patient has enjoyed excellent health Her ileostomy opening is functioning well and she has been eating whatever food she wished to She has gained about 20 lbs in weight and has become considerably more robust and well nourished Sigmoidoscopy up to 15 cm revealed a rather smooth mucosa with a film of purulent material covering it At about 6 cm, there were two small, nodular projections covered with mucosa

Third Operation—November 8, 1937 Combined abdominoperineal resection of rectum Five hundred cc of blood given by direct method immediately following the operation There was only a moderate reaction postoperatively, pulse, 120, temperature, 101 2° F, both becoming normal by the fifth postoperative day

Case 5—No 372,747 R S E, female, age 25, was examined at Roosevelt Hospital Clinic, June 1, 1933, giving a history of malaise three months previously followed by the gradual onset of diarrhea, seven or eight watery stools daily without blood, loss of ten pounds, present weight 96½ lbs Proctoscopic examination revealed a granular lusterless mucous membrane Scattered petechia-like spots of congestion, without ulceration or exudate on valves and in rectosigmoid Hemoglobin, 36 per cent, red blood cells, 2,150,000 Roentgenolgic examination showed what was interpreted to be a diffuse ulcerative appearance of the entire colon On May 7, 1934, she complained of mild abdominal cramps, progressive edema of the face, hands, and legs for a week, and she was having seven stools a day without blood, mucus, or pus Sigmoidoscopy up to 22 cm revealed the mucosa slightly granular, otherwise negative She had gained 17½ lbs (114) On February 14, 1935, roentgenologic examination of the colon showed changes in the mucosa which were essentially the same in the proximal colon, diameter larger, sigmoid and rectum smooth, indicating greater improvement than in the appearance of the colon On July 31, 1935, her condition was excellent, three semiformed stools a day, sigmoidoscopy up to 20 cm entirely normal

She was admitted to Roosevelt Hospital June 17, 1937 Five weeks previously there had been an insidious onset of diarrhea, accompanied by bright red blood in stools, which persisted and caused her considerable weakness She was given three transfusions, but the hemorrhagic diarrhea continued The patient was pale, slightly dehydrated, and appeared acutely ill There was a moderate amount of abdominal tenderness, most marked in the left upper quadrant Large rectovaginal fistula just proximal to the sphincter Sigmoidoscopy showed a subacute inflammatory process in the rectal mucosa, without definite ulcerations Four to 14 loose, bloody bowel movements daily Hemoglobin, 66 per cent, red blood count, 3,990,000

Operation—July 3, 1937 Exploratory celiotomy through a right rectus incision Entire colon involved Walls thick, edematous and indurated in areas A permanent transverse ileostomy was performed about six inches proximal to the ileocecal valve Proximal end of ileum dropped back Direct transfusion immediately following operation Postoperative course was quite smooth Ileostomy worked well, adjacent skin kept in good condition with a mixture of aluminum powder, mineral oil and zinc oxide

The patient was readmitted November 8, 1937, and appeared in good health She had gained 25 lbs, was eating all kinds of food, and the ileostomy was functioning well Occasional small seropurulent discharge from rectum Sigmoidoscopic examination revealed a congested mucous membrane and purulent discharge, no definite ulcerations The large rectovaginal fistula was still present

Second Operation—November 13, 1937 A subtotal colectomy was performed through a long, left paramedial incision No postoperative reaction Convalescence uneventful

Pathologic Examination—Beginning in the cecum and extending throughout the colon, are innumerable branching polypoid excrescences, measuring in the distal portion as much as 2 5 cm in length The tips of these polypi are dark and hemorrhagic, and all feel firm and fibrotic The lining of the colon is flattened and hemorrhagic, and in areas shows whitish plaques The lumen is considerably narrowed Microscopically

The mucous membrane is diffusely altered and hardly any of the original limits can be determined The muscularis mucosa seems to be destroyed and an infiltration extends under the epithelial surface and into the submucosa, consisting of leukocytes of all types, with many polymorphonuclear cells Many dilated capillaries seen, which are reduplicated Parts of the mucosa project in the form of polypi, apparently redundant mucous membrane of normal structure Scattered diffusely in the mucosa are nests of lymphocytes forming typical germinal centers *Diagnosis*—Chronic ulcerative colitis with diffuse polypoid transformation of the mucous membrane

Case 6—No 374,885 H DeV, colored, female, age 30, was admitted to Roosevelt Hospital November 8, 1937, complaining of loose watery stools which frequently contained mucus and blood, from which she had been suffering for the past 15 years She was first seen, in 1932, during a severe episode of diarrhea At that time, sigmoidoscopy revealed a granular, stiffened, ulcerated mucous membrane which bled easily Roentgenologic examination with a barium enema showed an ulcerative process involving the descending colon, sigmoid, and rectum, exactly the same roentgenologic findings as those seen in a subsequent examination, in 1935

She was given various medical, dietary, and supportive measures without any constant relief There were no definite allergies to explain the colitis, and bacteriologic studies revealed no specific etiologic agent

Physical Examination revealed a well developed but undernourished Negress There were no significant findings except the local condition There was moderate, generalized abdominal tenderness Sigmoidoscopy revealed a narrowed lumen of the rectum, with an injected and superficially ulcerated mucous membrane Roentgenologic examination with a barium enema showed an extensive colitis involving the colon, sigmoid and rectum, with moderate ulceration and a tube-like colon, without much flexibility, the "same picture" as had been seen five years previously, in 1932 There had been no extension of the process

Operation—November 15, 1937 Through a long, left paramedial incision, a transverse colostomy, in the healthy bowel above the involved area, was performed, and the descending colon was removed down to the lower sigmoid, where the distal sigmoid stump was brought out through the lower end of the incision She received a 500 cc direct blood transfusion

The ulcerative process began at the splenic flexure and went down through the sigmoid and rectosigmoid The bowel wall was thickened, boggy, edematous, and quite friable The fat epiploicae around the bowel were markedly hypertrophied

Her convalescence was uneventful

Pathologic Examination—Total length of specimen, 36 cm It is boggy and edematous and of considerable weight On section, there are apparently three distinct pathologic processes noted The proximal 15 cm showed follicular areas with minute hemorrhagic centers, without distorting to a great extent the above anatomy This appearance merges into an edematous swollen portion 9 cm in length, in which the mucous membrane shows many edematous and swollen folds, small fissures are noted distributed in a linear fashion The last portion reveals a fibrotic wall and the mucous membrane is flattened, hemorrhagic, and scarred

Microscopically The bowel shows a process which varies in degree, but not in type In the same involved section, there are noted increasingly larger areas in which the superficial mucous membrane is necrotic, and in these areas, there is an extraordinary degree of infiltration by polymorphonuclear leukocytes and red blood cells There are numerous foci where the surface is covered entirely by granulation tissue, heavily coated with lymphocytes and plasma cells and polymorphonuclear leukocytes This process extends throughout the submucosa and into the muscular bundles *Diagnosis*—Subacute and chronic suppurative colitis with ulceration

Complications—Among the numerous complications incident to chronic ulcerative colitis are strictures, developing in the course of healing in decidedly chronic cases, and usually without any change in symptoms Perforation of an ulcer occurs in less than 5 per cent of the cases, and is usually fatal The sigmoid flexure is a frequent site of perforation Fistula-in-ano and perirectal abscess develop from infected anal crypts, due to the purulent rectal discharge, fistulae burrow high up along the rectum originating from beneath the sphincter ani This causes discomfort and is unquestionably a serious complication Polyposis, not an infrequent complication, is recognized only in the chronic cases Carcinoma may be considered only indirectly as a complication of chronic ulcerative colitis, as it develops in an adenomatous polyp which in itself is a complication of the disease Thrombophlebitis, mesenteric thrombosis, skin lesions, endocarditis, achlorhydric gastritis and ocular diseases are to be classed as occasional and often late complications Rare complications, as had been pointed out recently by Bargen[9] and others, are colonic intussusception and colojejunogastric fistula

Effect of Colectomy Upon the Human—In an analytic study of 40 cases Whittaker[10] found that "a period of three months was necessary for these patients to regain their weight and strength" After this time it was not necessary that the bag or dressing be changed during the night It has been noted that the ileum assumes the function of the colon and enlarges after removal of the entire colon and rectum, also that there is no marked disturbance in mineral metabolism, the chlorides in the blood plasma and the serum calcium were found to be only temporarily reduced after ileostomy

In our own small series, carefully and frequently observed since colectomy, we have found they manage the ideal stoma without undue inconvenience, their mental attitude is surprisingly cheerful, they possess a feeling of well-being due no doubt to their extraordinary gain in weight, and look hopefully to the future

CONCLUSIONS

Apart from acute emergencies such as intestinal obstruction, impending perforations and massive hemorrhage, surgery should be withheld until two factors have been evaluated (1) The clinical response to conservative treatment, and (2) the extent of permanent damage to the colon

In the intractable cases medical treatment has been proven merely palliative, not curative, these patients die unless the diseased colon is removed I am convinced that with adequate and prolonged preoperative preparation, the advantageous effects of self-immunization and the adherence to certain fundamental surgical principles, the entire diseased bowel can be removed without exceptional risk

To increase the margin of safety three, and at times four stages are necessary

The ileal stoma takes on some of the characteristics of a rectum, only after complete removal of the entire colon and rectum

No permanent deleterious results have been found to occur in the human following total colectomy

REFERENCES

[1] Cattell, Richard B Personal communication
[2] Kunath, C A Chronic Ulcerative Colitis Arch Surg, 32, 302–319, February, 1936
[3] Lilienthal, Howard Hyperplastic Colitis Extirpation of the Entire Colon, the Upper Portion of the Sigmoid Flexure and Four Inches of the Ileum Amer Med, N Y Ac of Med No 16237, April, 1901
[4] Rankin, Fred W Total Colectomy, Its Indication and Technique ANNALS OF SURGERY, 94, 677–704, October, 1931
[5] Rankin, Fred W Colectomy for Adenomatosis and Pseudopolypoydosis ANNALS OF SURGERY, 102, 707, October, 1935
[6] Cattell, Richard B Personal communication
[7] Whittaker, L D Observations of the Human Being Following Colectomy or Colonic Exclusion with Ileostomy Proc Staff Meet Mayo Clin, 12, 183, March 24, 1937
[8] Rankin, Fred W Personal communication
[9] Bargen, J Arnold, Kerr, I G, Hausner, Erich, and Weber, H M Rare Complications of Chronic Ulcerative Colitis Proc Staff Meet Mayo Clin, 12, 385, June 23, 1937
[10] Whittaker, L D Observations of the Human Being following Colectomy or Colonic Exclusion with Ileostomy Proc Staff Meet Mayo Clin, 12, 183, March 24, 1937

DISCUSSION —DR FREDERIC W BANCROFT (New York, N Y) I should like to call attention to the fact that some patients with an ileostomy can remain well with it alone, and without the subsequent complete removal of the bowel, and also that in an occasional case the ileostomy can be reimplanted One patient whom I have seen has had an ileostomy for eight years without having had any further colon exploration Her weight has remained constant She came to me for examination to find out if she could go through a pregnancy On one case I performed an ileostomy for a marked, general ulcerative colitis, and three years later the ileum was implanted into the ascending colon A follow-up of two and one-half years showed no recurrence and the man is well A third patient who had a very severe series of postoperative complications following an ileostomy had an implantation of it into the transverse colon after three years This was followed a year later by a right-sided colectomy, leaving the original anastomosis in situ It is now two years since this procedure, and he continues his everyday life His roentgenograms show some constriction of the descending colon, but he has no blood and no pain, has one to two stools a day and has gained weight As he is now 58 years old, and it is five years since his original ileostomy, it would seem that he has had at least five satisfactory years of life and that he may continue well for the remainder of his life expectancy

DR JOHN C A GERSTER (New York, N Y) I would like to cite a case of Dr DeWitt Stetten's, of a nurse who had a cecostomy performed for chronic ulcerative colitis some years ago She came for closure of the cecostomy Roentgenograms showed a cecal pouch and a rectal ampulla of normal size—the rest of the colon showed a mere thread of barium—evidence of cicatricial healing years after operation

DR FRED W RANKIN (Lexington, Ky) Doctor Cave has selected for discussion one of the most difficult entities we have to treat I think we should not labor under the impression that this surgical procedure is simple and one easily conducted

Total or subtotal colectomy carried out in multiple stages is a formidable operation, despite the fact that the operative mortality in expert hands is reasonable Subtotal colectomy, while an ideal operation, is applicable only to a small group of cases of the chronic ulcerative colitis variety, and I be-

lieve in most instances extirpation of the entire colon, leaving an artificial stoma, will be indicated for the very reason that a chronic, intractable ulcerative colitis which is amenable to surgery is attacked for one or two reasons First, the lead-pipe colon filled with pus has become a source of infection, and second, the pseudopolypi, which are the result of the inflammatory process, undergo degenerative changes, which occur in about 10 per cent of the cases

I am prompted to say a few words about ileostomy, because of the remark about mortality and the question of closing the stoma The mortality has been excessively high and I think will continue to be higher than with colectomy, for the reason that these patients are extremely bad surgical risks I think the surgeon should accept the roentgenographic diagnosis of ulcerative colitis rather than to explore the abdomen I have had the unpleasant experience of sticking a finger through an ulcer, when the colon is full of them, and had a resulting peritonitis I do believe ileostomy is indicated in ordinary difficult cases much less frequently than was formerly believed I can remember many years ago, when assisting Doctor Sistrunk, that we operated with a great deal of reluctance, and the mortality was high and the end-results poor As something more was found out about the disease and proper medical regimens were instituted only the extremely intractable case is now subjected to surgery It has been our experience that once an ileostomy, always an ileostomy

I have not had the experience of Doctor Bancroft, but have, under pressure, twice closed an ileostomy only to have to reestablish it again, and another case developed a peritonitis and died I do not believe one can get away with it very often, and have a gastro-intestinal tract that will function as formerly I am inclined to agree with the late Dr Daniel Jones, that it is doubtful if chronic ulcerative colitis can be completely cured without removal of the colon Segmental chronic ulcerative colitis is a very rare disease In 95 per cent of cases we find it starts in the rectum and the lower sigmoid, and extends around the colon, and we do not have an opportunity to save the sphincteric mechanism Fortunately, these people, after the ileostomy has been established, vaccinate themselves against infection

It is gratifying to have a report such as Doctor Cave has given us, which demonstrates the advantages of the multiple stage operations in total or subtotal colectomy for intractable ulcerative colitis, and I think he is to be congratulated upon his mortality percentage in this group of cases This seems a further demonstration of a hypothesis that many of us believe in, namely, that under certain conditions intractable chronic ulcerative colitis becomes essentially a surgical entity, albeit surgery is a formidable procedure, to be undertaken only under cooperative management and by skilled hands

DR HENRY W CAVE (closing) I think Doctor Bancroft is right in stating that a certain number of these patients will seem apparently cured for four or five years following ileostomy alone, but I do believe that the intractable cases will not be completely and thoroughly cured until the diseased colon is removed

It is well to bear in mind Doctor Rankin's suggestion that a rubber guarded clamp should be used in dividing the friable, diseased bowel, for fatal soiling may ensue if a crushing clamp is employed

THE RETROPERITONEAL (RETROCOLIC) APPENDIX

WILLIAM B MARBURY, M D
WASHINGTON, D C

THE purpose of this communication is to report six cases of retrocolic appendix that have come under the writer's care during the past three years, and to draw a comparison between the different methods of management

In the literature the captions retrocecal, retroperitoneal, extraperitoneal and retrocolic appear to be used more or less interchangeably and are often misleading It would seem more correct to speak of the appendix as retrocecal when it is limited by the space behind the caput cecum, and retrocolic when it extends upward behind the ascending colon Most retrocolic appendices are also retroperitoneal, but this does not follow in regard to the retrocecal type, which usually lies free and has a complete peritoneal investment For example, as Lee[14] has demonstrated, the cecum may overlie the appendix or the appendix may extend upward toward the liver alongside of and attached to the outer leaf of the mesentery of the ascending colon but still be intraperitoneal Occasionally, the appendix may be intercepted in its descent and become both retrocecal and retroperitoneal, even retrocolic, extending upward for a considerable distance But of all the possible positions which the appendix may thus assume, the commonest and most frequent is the retrocecal

It would seem that the appellation retrocecal is often used where the more pathologic retrocolic condition is intended Thus, when Hofmann[7] stated "When sufficiently long, the retrocecal appendix may reach the lower pole of the kidney or even the gallbladder," he actually described a retrocolic appendix The almost universal acceptance of the retrocecal position as abnormal probably has its genesis in the statement by Sir Frederick Treves,[25] in 1885, that the usual position for the appendix was behind the end of the ileum and its mesentery, and pointed toward the spleen This doctrine prevailed without contradiction until 1924, when Gladstone and Wakely[6] instituted the first of a series of investigations into its validity, and in their initial group, comprising 3,000 subjects, they found retrocecal and retrocolic appendices in 2,076 cases, or 69 2 per cent In 1933, Wakely[27] alone reported 6,582 instances of the retrocecal position among 10,000 cases, or 65 82 per cent In 200 consecutive appendicectomies, Bushey[2] noted a retrocecal position in 30 per cent, and retroperitoneal as well as retrocecal position in 7 per cent Unfortunately, in common with virtually all other writers on the subject, these authors failed to distinguish between the retrocolic and retrocecal position

In the present communication, by retrocolic or retroperitoneal (since most retrocolic appendices are also retroperitoneal) is meant an appendix extending upward for a variable distance behind the ascending colon which, when the abdomen is opened, cannot be seen or felt except at its attachment to the cecum Inasmuch as it has been shown that the appendix is found in a retro-

cecal position in a great majority of cases, it appears logical to conclude that the retrocecal position is normal and the retrocolic abnormal

The relative position of the appendix in the body and its relation to the peritoneum are governed entirely by embryologic conditions During approximately the fourth month of gestation the cecum leaves its position in the left side of the abdomen, ascends, and with its mesenteric attachment as a sort of handle, rotates in the form of a partly open fan into the right iliac fossa However, ascent and rotation may cease at any point, hence the appendix may be found anywhere along the course described by the cecum, that is, in any region from the point of its original formation below and to the left of the umbilicus along the line of the transverse and ascending colon to the iliac fossa (Fig 1)

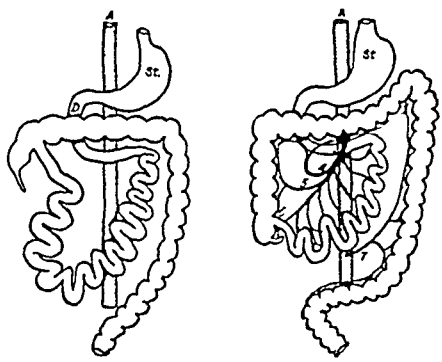


Fig 1.—(a) Development of intestinal canal with formation and rotation of umbilical loop Further rotation of loop ileocecal junction being in subhepatic position (b) Development of intestinal canal with formation and rotation of umbilical loop After descent of cecum to right iliac fossa (after Huntington)

The other factor which contributes to what position the appendix may take, whether retrocecal, retrocolic or free in the peritoneal cavity, is the development of the cecum At any early date the outer and anterior walls of the cecum develop at the expense of the mesial and posterior walls This has a tendency to make the appendix take a posterior and upward position Added to this, if the meso-appendix is short it is likely to take a posterior position in relation to the cecum With these factors in mind, it only remains to realize that the appendix may become attached to the posterior parietal peritoneum at any time during the descent of the colon If this occurs early in the descent, the tip of the appendix will be found in the region of the gallbladder, if late, in a retrocecal position, or if not at all, it will be free in the peritoneal cavity and may extend down into the pelvis

History and Incidence.—Excellent descriptions of the purely anatomic type of retroperitoneal appendix, in contrast to that due to pathologic processes, were presented by Thomas,[23] in 1913 In one of his specimens apparently the cecum, appendix, and terminal ileum had adhered to the peritoneum in the iliac fossa and subsequently became retroperitoneal in position In another, the vermiform process had, during the descent of the cecum, assumed a

vertical position behind the lateral edge of the colon, and in the course of the absorption of the posterior investment of the right colon, had come to lie outside of the peritoneal cavity Postmortem statistics published previously to 1915, and collected by Strauss[21] in that year, show 22 extraperitoneal appendices found in 1,651 autopsies

The number of clinical cases of retroperitoneal appendices thus far reported is even smaller than that found in existing postmortem records Apparently, the earliest account of the observation of such a case was contributed, in 1901, by Holmes [8] In this instance, the proximal portion of the appendix alone was situated extraperitoneally, while the distal portion was free Three years later, Briggs[1] cited the case of a girl, age 20, who had had three previous attacks of appendicular colic, upon whom he operated during a free interval, and found the tip of the appendix to be both retrocecal and extraperitoneal Kelly and Hurdon,[12] in 1905, described a buried retrocecal appendix operated upon by Follis, who succeeded in first locating the firm organ by palpation through the cecum, and then exposing it in its retroperitoneal position from the cecal end by an incision through the peritoneum Kelly[11] subsequently cited an unusual case operated upon by Finney, in 1898, in which a retrocolic appendix was not only situated behind the peritoneum, but actually lay with its tip buried in the substance of the psoas muscle

In 1915, Strauss[21] published brief histories of five cases operated upon by his colleague, Beers, at intervals between 1908 and 1914 Two of these exhibited neither psoas spasm nor any other unusual sign suggestive of an abnormally situated appendix Two were of the definitely acute type, extending upward and lying near the kidney, thus presenting the aspect of a perinephritic abscess In the first case an extraperitoneal appendix, undiscovered when draining an abscess in the lumbar region, subsequently formed a persistent fecal fistula

Small,[19] in 1928, reported the largest single group of cases of retroperitoneal appendices, seven in all, observed and operated upon by him within a period of 25 years In this series it is notable that six patients (five boys and one girl) were under age 16 Appendicectomies were performed successfully in all but one case, in which no appendix was found

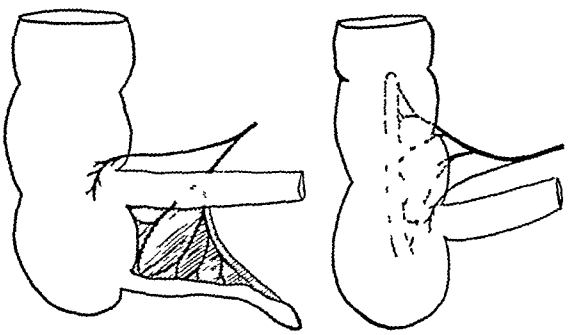
The incidence of acute inflammation in relation to the position of the appendix formed the object of a special study by Busher,[2] who found that it occurred three and five times as frequently in retrocecal and retroperitoneal appendices respectively as in so-called normally situated appendices Busher concluded that the retrocecal position, especially when it is also retroperitoneal, renders the appendix peculiarly susceptible to acute inflammation MacLeod[15] states that a retroperitoneal position closely related to the right ureter favors obstruction at the point where the appendix bends toward its junction with the cecum It has been suggested by some writers that irritation from the closely contiguous psoas muscle may assume importance as an etiologic factor Moreover, as Small[19] points out, a retroperitoneal appendix is relatively liable to disease because it is cut off from the direct superior mesenteric circulation

Symptoms and Diagnosis—There are no pathognomonic symptoms of the retroperitoneal appendix, though there are a few significant factors which it might be well to take into consideration The onset of pain in the epigastrium, followed by nausea and vomiting, is frequently noted, but the later localized pain over McBurney's point may be definitely modified or absent since the superior mesenteric plexus receives no impulse from local irritation of the peritoneum Muscle spasm, also, is not a reliable symptom, especially of the anterior abdominal wall The tender point is more apt to be above the crest of the ilium in the loin It is more or less characteristic of this type of appendix that, after the initial onset, the patient does not complain of much pain, but since the infectious process remains and is continuous its accompaniments of elevated temperature and accelerated pulse are criteria of great value Some authors have laid great stress on the frequency with which blood is found in the urine, but this phenomenon did not occur in any of the cases herewith reported As might be suspected, in place of spasm of the abdominal muscles there is often irritation of the psoas muscle, due to the close proximity of the inflamed appendix, which results in the contraction and flexion of the right thigh on the abdomen Palpation seldom reveals a mass, such as is not infrequently found in the ordinary type of appendicitis where the omentum is attached to the inflamed viscus

As has been intimated above, after the initial onset, the patient may assume a more or less lethargic state which may simulate a medical condition, such as typhoid fever or tuberculosis In the more acute form it may be difficult to diagnose it from pyelitis, particularly if there happen to be blood and pus in the urine Even in neglected cases there is much less danger of general peritonitis than where the appendix is free in the peritoneal cavity, but on the other hand, grave consequences can result from the spreading of pus in the retroperitoneal space, and Jackson[9] has reported complications which included subdiaphragmatic abscess, infection of the pleural cavity with bronchial fistula, and when the infection extended downward along the psoas muscle, large abscess in the thigh of the right leg extending down even to the knee Consequently, in the absence of any definite diagnostic symptom, one should put great stress on the early history of the acute onset with epigastric pain, associated either with, or followed by, nausea and vomiting, particularly when, after a lapse of time, six to eight hours, the usual point of maximum tenderness over McBurney's point does not develop The danger is not in mistaking the occurrence of appendicitis in one anatomic position for another, but in being led into the erroneous belief that an acute surgical condition does not exist

Treatment—The treatment in this form, as in all forms of acute appendicitis, is operative, unless the patient's condition does not justify immediate sugical intervention A McBurney incision is made and the appendix sought for in its usual situation If it is not found free or extending anteriorly or into the pelvis, the base at least can be located by palpation at the junction of

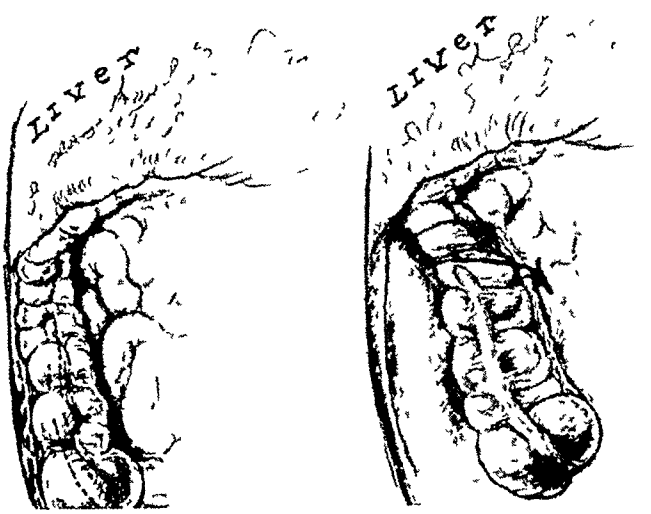
the longitudinal bands of the cecum Spivak has shown that, in 90 per cent of cases of retrocolic appendix, there is a definite Lane kink, and warns that a retrocolic appendix should be suspected wherever this condition obtains Such a condition presents certain technical difficulties, and it is hazardous to remove the appendix through the ordinary incision because, as is demonstrated



(a) (b)

FIG 2—(a) Course and branches of ileocolic artery (b) Course of ileocolic artery when appendix is in retrocolic position (after Durrach—Johnson's Operative Therapeusis)

in Cases 1 and 2 of this series, the probability of rupturing the appendix is great Therefore, it is better to extend the original incision upward and laterally as far as may be necessary The external oblique can be split along the course of its fibers, but the internal oblique and transversalis will have to



(a) (b)

FIG 3—(a) Retrocolic appendix (b) Ascending colon reflected medially so as to expose appendix

be cut across This will probably sacrifice the iliohypogastric nerve, but this is of small consequence when considered in relation to the seriousness of an inadequate exposure In the first two cases of this series this mistake was made, and an attempt was made to remove the appendix by freeing it from below In both cases the appendix was ruptured several inches from its base In the first the tip was not recovered and the postcolic area was drained, in

the latter, in an effort to remove the firmly attached distal portion, evidently a branch of the ileocecal artery was ruptured, which caused very troublesome bleeding and necessitated, in the end, enlargement of the incision and a reflection of the colon in order to tie it off (Fig 2) The third case in this series indicates how subtle the symptoms may be from a retrocolic appendix, as the patient after an acute onset settled down to a rather chronic state of mild discomfort and during the 12 days which elapsed between the onset of the condition and operation he was up and around at intervals On opening the retrocolic space about one-half pint of pus was evacuated and the entire ascending colon seemed to be raised from its bed In the remaining three cases, which were unruptured, though definitely acute, the outer leaf of the mesentery was incised and the colon reflected mesially (Fig 3), thereby bringing the appendix into view for its entire length This is important because the distal end is usually the site of the greatest pathology

CASE HISTORIES

Case 1—D D, white male age 27, was taken ill at noon July 28, 1935, with abdominal pain, nausea and vomiting When seen at 3 00 A M on the following day, he was in bed with his knees drawn up and declared he felt as if his abdomen were "breaking" Temperature and leukocyte count were normal There was no history of previous attacks The abdomen was not distended but there was marked tenderness over McBurney's point and muscle spasm Admitted to hospital July 29, 1935, 18 hours after the onset of his symptoms

Operation—Abdomen opened through a McBurney incision On examining the cecum and terminal ileum, the appendix could be neither seen nor felt A retroperitoneal appendix was suspected, and the base was uncovered through a small opening in the peritoneum The base of the appendix appeared to be normal, by blunt dissection and traction it was worked down toward the tip which extended upward behind the ascending colon After about four inches had been exposed, the appendix suddenly parted, leaving the tip which could be felt but not seen or 'headed up" because of its firm attachment As there was some soiling, it was deemed advisable not to explore further and a drain was inserted

A postoperative chill was followed by an axillary temperature of 103 6° F After 59 days in the hospital the patient was discharged with some drainage from the wound His principal complication was a thrombophlebitis of the left leg

Case 2—W C P, white, male, age 28, when seen November 5, 1935, stated that he had been taken sick that day with pain in the right lower quadrant and nausea, and had suffered a similar attack two weeks previous No cathartics had been taken He had had diarrhea for two or three days

Physical Examination was negative except for tenderness over McBurney's point and a moderate degree of muscular spasm Leukocyte count, 13,800 Urine, negative A diagnosis of acute appendicitis was made

Operation—Under avertin and gas anesthesia, the abdomen was opened, and exploration revealed only the base of the appendix, the remaining portion was retroperitoneal and extended upward behind the cecum and ascending colon By traction on the base and blunt dissection about two and one-half inches were freed Above this there could be felt a bulbous mass which tore in two in an effort to remove it, and discharged a small amount of foul-smelling pus The stump was ligated and inverted in the usual manner An endeavor was made to remove the distal portion, but in doing so many dense adhesions had to be freed entirely by the sense of touch, as they could not be visualized Apparently there was no line of cleavage between the appendix and the surrounding tissue In removing the distal portion a branch of the ileocecal artery was

ruptured and bled freely After an unsuccessful attempt to control this by packing, the wound was enlarged, the ascending colon freed on its outer aspect and carried mesially, and the bleeding point ligated A drain was inserted behind the cecum and the wound closed, care being taken to approximate muscles cut across

Following a transfusion, the immediate postoperative course was satisfactory On the twelfth day, however, the temperature rose to 101° F, and for the next four weeks the patient ran a septic temperature On the twenty-first day he had a chill and his temperature rose to 106° F On the thirty-eighth day there was fecal drainage and discharge of an enema from the wound From then onward the patient improved and was discharged one week later

Case 3—J R, white, male, age 43, was admitted to the hospital January 4, 1937, complaining of abdominal pain, and stated that he had been ill 12 days, having experienced sharp pain in the abdomen associated with diarrhea December 23, 1936 There had been no previous, similar attacks, but he had had some indigestion without nausea and vomiting

Physical Examination—There were pain and tenderness on the right side about two fingers' breadth below the costal margin A mass could be made out in this region, apparently unconnected with the liver but extending somewhat toward the flank Fist percussion over right kidney was negative Temperature, 102° F, pulse, 108 Leukocytes, 22,500, polymorphonuclears, 90 per cent *Diagnosis* Appendiceal abscess

Operation—January 4, 1937 A high muscle-splitting incision, which was later enlarged, was made over the mass Small Mikulicz pads were inserted to wall off the free peritoneal cavity A fibrous exudate was seen at the outer margin of the ascending colon A small incision, made in the outer leaf of the colon, permitted retraction mesially Gradually, by blunt dissection, the abscess, which seemed to extend as far as the liver, was broken into and six or eight ounces of foul-smelling pus evacuated Two cigarette drains were inserted The appendix could not be located

This patient made a very satisfactory recovery His temperature returned to normal on the seventh and he was up on the eleventh postoperative day There was some drainage for about three weeks

Case 4—N S B, white, female, age 28, was admitted to the hospital February 15, 1937, complaining of pain in the right lower quadrant, and stated that she had been taken sick on the previous day with nausea and vomiting and had been given castor oil Temperature, 99° F, leukocytes, 21,000 Urine, negative

Operation—February 15, 1937 McBurney incision The appendix could not be located in its usual situation, but the base could be felt beneath the cecum It was impossible to explore it through the existing excision, the internal oblique muscle, therefore, was split upward and backward and another opening made through the internal oblique and transversalis in the direction of their fibers The appendix lay along the outer border of the ascending colon, its distal end was acutely inflamed and bulbous but not ruptured It was removed by working first through the upper and then the lower openings without cutting across any muscle The patient made an uneventful recovery and was discharged on the tenth postoperative day

Case 5—J E, white, male, age 26, was admitted to the hospital June 12, 1937, complaining of pain in right lower quadrant and nausea but no vomiting When seen the patient had been ill 24 hours There was a history of a previous attack in 1935

Physical Examination was essentially negative except for the abdomen, where tenderness extended upward from McBurney's point and into the right flank There was some muscle spasm Temperature, 99° F, leukoctyes, 15,200 Urine, negative

Operation—McBurney incision The appendix could not be located at first, but was finally felt behind the cecum The abdominal incision was enlarged upward and backward by splitting the external oblique and cutting across the internal oblique and transversalis The outer leaf of the ascending colon was incised and the colon turned mesially, exposing a long, bulbous appendix which extended to the lower margin of the liver The distal third was gangrenous and densely attached to its bed, it was removed

by blunt and sharp dissection, without rupture The wound was closed without drainage, care being taken to approximate the muscles with mattress sutures The patient left the hospital on the eleventh postoperative day

Case 6.—K Y, colored, male, age 21, was seen relative to his present illness January 5, 1937, and was complaining of epigastric pain, nausea and vomiting He had been in the hospital since November 17, 1936, with a badly comminuted fracture of the right ilium and was still in a plaster encasement The pain followed the taking of a cathartic, which had resulted in several bowel movements He had had a sore throat the previous week The plaster encasement was cut to expose the abdomen Examination revealed a definite tenderness over McBurney's point with some muscle spasm Temperature, 99.8° F Leukocyte count, 20,800, polymorphonuclears, 85 per cent Urine, negative

Operation.—January 6, 1937 McBurney incision No free fluid It was difficult to locate the appendix, although the cecum appeared rather free It was finally found behind the cecum and ascending colon and extended nearly to the liver In order to explore it, it was necessary to extend the incision and reflect the colon mesially It was acutely inflamed, especially in its distal portion It was removed and the stump turned in Wound closed without drainage

Patient had an uneventful convalescence for the first week, and then following a chill his temperature went to 104° F, and two days later 105.4° F, pulse, 136 After two days the temperature became normal The exact cause of this acute flare-up was not determined, but the probable diagnosis at one time was a pylethrombosis, pylephlebitis or subdiaphragmatic abscess

TABLE I

RESUMÉ OF DATA RELEVANT TO SIX CASES OF RETROCOLIC APPENDICITIS

	Name and Date	Age and Sex	Onset before Oper	Laboratory Data	Condition at Oper	Complications	Days in Hospital	Cathartic	Result
1	D C 7 28 35	29 M	18 hrs	W B C 7 600 Polys 70% Urine negative	Retrocolic Not ruptured Drained	Ruptured during removal Phlebitis	59	No	Good
2	W P 11 3 35	27 M	26 hrs	W B C 13 800 Polys 80% Urine negative	Retrocolic Not ruptured Drained	Ruptured during removal Hemorrhage Fistula	36	No	Good
3	J R 1-4 37	47 M	12 days	W B C 22 650 Polys 90% Urine negative	Retrocolic Abscess Drained	None	25	Yes Diarrhea	Good
4	N B 2 15 37	28 F	24 hrs	W B C 21 000 Polys 93% Urine negative	Retrocolic Acute	None	10	Yes	Good
5	J E 0 12-37	26 M	24 hrs	W B C 15 200 Polys 85% Urine negative	Retrocolic Acute	None	11	No	Good
6	K Y 1 6 37	21 M	48 hrs	W B C 20 800 Polys 85% Urine negative	Retrocolic Acute	T 105.4° F postoper	21 approx	Yes Diarrhea	Good

Résumé of Table I.—Six males and one female Onset before operation One to 12 days Complications Two appendices ruptured during removal, one phlebitis, one hemorrhage and fecal fistula Days in hospital Longest 59 shortest ten Average for Cases 1 and 2 47.5 days, Cases 3 and 6 16.7 days

Discussion—Since the mortality in appendicitis can be reduced approximately 15 per cent by employing a McBurney incision in cases where the appendix is ruptured and there is an abscess present, it would seem best in all cases where appendicitis is suspected to make this incision The reason for the difference in mortality is that the approach is immediately over the abscess and there is little danger of contaminating the previously clean peritoneal cavity The objection is often made that this incision is not adequate and that other possible existing pathology cannot be properly taken care of This would be true if one were unwilling to enlarge the incision, or make another one, where the occasion demanded

It is possible to draw a comparison between the first two cases herein cited and the last four In the former an attempt was made to remove, in the usual manner, an appendix which extended up behind the colon, and in both cases the appendix was pulled in two In both cases there resulted a severe infection with prolonged drainage and complications

In the last four cases, the appendix was visualized for its entire length by two additional procedures, *i e*, extending the incision in the external oblique and cutting across the internal oblique and transversalis muscles and mobilizing the ascending colon by an incision along its outer reflection Case 3 differed from the others in that there was an already existing abscess about two fingers' breadth below the costal margin which was easily discernible through the abdominal wall The abscess was drained through a high muscle-splitting incision by incising the peritoneum lateral to the colon While this is not a new procedure, I have the temerity to present these cases suspecting that some others may have had difficulty along these same lines, and believing that only by familiarizing ourselves with what has proven to be efficacious in the past are we able to escape losing the benefit to be derived from those experiences and observations and apply them to present procedures

CONCLUSIONS

(1) A distinction should be made between retrocolic (or retroperitoneal) and retrocecal appendix

(2) The appendix is retrocolic in about 7 per cent of cases

(3) The McBurney incision is the one of choice when the diagnosis is "appendicitis," but it should be extended upward or downward, even at the expense of severing muscles, when the necessity demands

(4) Where the appendix is retrocolic, the ascending colon should be reflected mesially so as to expose the appendix for its entire length

(5) There is little or no danger of hernia if the muscles cut across are carefully repaired

REFERENCES

[1] Briggs, C E Extraperitoneal Relations of Appendix Vermiformis to Posterior Surface of Cecum, with Report of a Form Hitherto Undescribed Med News, **85**, 116–119, 1904

[2] Busher, H Retrocecal Appendicitis Minnesota Med, **14**, 717 1931

[3] Cohn, I Retroperitoneal Appendix New Orleans M & S J, 68, 523–524, 1915–1916
[4] Craig, J D Variations in Relations of Vermiform Appendix from Standpoint of Embryology Tr M Soc, N Y, 355–367, 1898
[5] Donald, D C Acute Retroperitoneal Appendicitis South M J, 18, 364–368, 1925
[6] Gladstone, R J, and Wakely, C P G Relative Frequency of Various Positions of Vermiform Appendix, as Ascertained by an Analysis of 3,000 Cases, with an Account of Its Development Brit J Surg, 11, 503–520, 1924
[7] Hofmann, A H Ueber die Lage des Wurmfortsatzes Deutsche med Wchnschr, 48, 939–941, 1922
[8] Holmes, E W Appendix Vermiformis Penn M J, 5, 204–207, 1901–1902
[9] Jackson, J N Retrocecal Appendicitis Tr West Surg Assn, 22, 79–92, 1912
[10] Johnson's Operative Therapeusis, 4, 444–449
[11] Kelly, H A Appendicitis and Other Diseases of the Vermiform Appendix Philadelphia, J B Lippincott Co, 1909
[12] Kelly, H A, and Hurdon, E Vermiform Appendix and Its Diseases Philadelphia, W B Saunders & Co, 1905
[13] Klots "Retrocecal Appendix" (Dutch) Geneesk Gids, 5, 481–488, 1927
[14] Lee, Q B Dallas, J M, 22, 22–24, 1936
[15] MacLeod, C Some Observations on Acute Appendicitis Postgrad M J, 13, 170–184, 1937
[16] McClure and Altemeier Acute Perforated Appendicitis with Peritonitis Annals of Surgery, 103, 800, May, 1936
[17] Meyer, W The Additional Posterior Incision in Certain Cases of Operation for the Inflamed Retrocecal Appendix Annals of Surgery, 80, 511–518, 1924
[18] Morison, quoted by Wolford, T Retrocecal Appendices N Orleans M & S J, 87, 622–624, 1934-1935
[19] Small, A B The Retroperitoneal Appendix Texas State J M, 24, 550–555, 1928–1929
[20] Sprengel, O Appendicitis Deutsche Chir, 46, 1906
[21] Strauss, A Clinical Aspect of Disease of the Extraperitoneal Appendix Vermiformis Surg, Gynec & Obstet, 21, 318-320, 1915
[22] Tennant, C E The Congenital Extraperitoneal Appendix Tr West Surg Assn, 37, 81–96, 1927
[23] Thomas, T T Retroperitoneal Appendix Annals of Surgery, 70, 124–125, 1919
[24] Thomson, R B Note on Retroperitoneal Position of the Vermiform Process or Appendix South African M Rec, 11, 413–416, 1913
[25] Treves, F Anatomy of Intestinal Canal and Peritoneum in Man Brit M J, 1, 415–470, 527–580, 1885
[26] Wakely, C P G, and Gladstone, R J Relative Frequency of Various Positions of Vermiform Appendix as Ascertained by an Analysis of 5,000 Cases Lancet, 1, 178–179, 1928
[27] Wakely, C P G Position of Vermiform Appendix as Ascertained by an Analysis of 10,000 Cases J Anat, 67, 277–283, 1933

UNILOCULAR CYST OF LIVER

EDWARD H OCHSNER, B S, M D
CHICAGO, ILL

IN REVIEWING the literature on nonparasitic cysts of the liver, no report was found of a case in which the size of the cyst equalled that of the one herewith reported, which was operated upon in 1929 The extraordinary size of the cyst and the opportunity offered to observe the operative result a year later, incident to a celiotomy for another condition, prompts its report

Solitary nonparasitic cysts of the liver are rarely encountered Ottenheimer[6] states that Moschowitz reviewed the subject, in 1906, and could find only 85 cases reported in the literature Muto and Hanzawa[5] cited one personal case, and tabulated 81 others reported between 1900–1927, including five cases reported by Japanese surgeons Maes[3] states "Simple cysts of large size containing several pints of clear fluid are rarely encountered"

Numerous theories have been advanced by the different authors relative to the etiology of simple cysts of the liver They all admit, however, that nothing definite is known regarding their etiology

Nonparasitic cysts of the liver have been observed in persons of all ages Stoesser and Wangensteen[9] report one which occurred in a fetus, which was so large that it prevented the normal delivery of the child, and also mention the fact that a simple cyst had been found in a woman, age 75 Eliason[2] and a number of other authors state that they are found most frequently during the fifth and sixth decades

All authors have noted that cysts of the type under consideration occur much more frequently in females than in males, the incidence varying from 3 1 to 4 1

Although simple cysts may occur in either lobe or in any portion of the liver, many more have been found in the right lobe than in the left, and a majority have been found on the under surface and edge of the liver

A correct preoperative diagnosis is difficult McGlannon[4] states "Clinically, solitary nonparasitic cysts of the liver have no signs or symptoms to make a preoperative diagnosis certain" Ackman and Rhea[1] say "The clinical signs are rarely characteristic enough to permit of a positive diagnosis except at operation" Orr and Thurston[7] analyzed 75 cases from the literature, only three of which were correctly diagnosed preoperatively, and remark that most of them were mistaken for hydrops of the gallbladder, or ovarian, pancreatic or mesenteric cysts

The cysts vary greatly in size The smallest one was the size of an orange, and the largest one (Stoesser and Wangensteen[9]), operated upon by Cousins, contained two and one-half gallons of fluid

The only treatment that offers any possibility of permanent relief is surgery Pairy[8] reports one case in which he found it possible to dissect out the cyst completely, cover over the raw surface with fine catgut sutures and close the abdomen without drainage With the larger nonpedunculated cysts this procedure is not advisable The generally practiced procedure is to marsupialize the portion of the cyst that cannot be safely removed This method, although it necessitates a little longer hospitalization, is safer, and is the one recommended

The following data are taken from the history of a patient who was first examined on May 5, 1929, from whom there was subsequently removed a nonparasitic cyst of the liver which contained more than four gallons of fluid

Case Report—N W, white, female, married, age 56, was first examined May 5, 1929 She had noticed a generalized enlargement of the abdomen, which had been gradually increasing during the past three years, for the past five months she had suffered from lumbar backache and discomfort when sitting Menstrual history Menses at 16, married at 33, first pregnancy at 37, labor normal with the exception of an episiotomy, second pregnancy at 39, lacerations which were repaired but stitches did not hold, menopause at age 46

Physical Examination—Abdomen uniformly and markedly distended, general dulness, greatest circumference 38 inches Perineum, third degree laceration, complete prolapse of uterus and bladder when standing Urine and blood normal Weight, 137½ pounds *Diagnosis*—Ovarian cyst, lacerated perineum, uterine prolapse, cystocele

She was admitted to the Augustana Hospital, May 28, 1929, and was operated upon the following day Under ether anesthesia, the abdomen was explored through a low median incision A cyst was found which apparently originated in the liver, and which completely filled the abdominal cavity The incision was extended upward to midway between the umbilicus and ensiform cartilage, further examination demonstrated that the cyst was attached to the under surface, edge and upper surface of the right lobe of the liver, which was not enlarged, gallbladder normal The cyst was aspirated through a large trocar and cannula, and three and one-half gallons (actual measurement) of murky fluid were evacuated, because of the friability of the cyst wall, at least half a gallon of the fluid content was lost during the aspiration As much of the cyst as could be safely removed without causing hemorrhage from the liver was excised The cyst wall was thin, smooth, and contained no trabeculations or compartments, the small remaining portion of the cyst wall was brought around a glass drainage tube, covered with gauze and rubber dam and then sutured into the upper angle of the abdominal wound, the remainder of the wound was closed

Some drainage continued from the unexcised portion of the cyst for two months Recovery was uneventful, however, except for a moderate rise in temperature on several occasions when the drain did not function properly The patient was discharged July 13, 1929 Weight, 109 pounds On October 8, 1929, she had gained 11½ pounds

Pathologic Diagnosis—"Cyst wall is lined with low columnar epithelium No evidence of coccidiosis"

Subsequent Course—The patient was readmitted to the Augustana Hospital, September 11, 1930, for repair of the lacerated perineum and suspension of the prolapsed uterus She was operated upon September 12, 1930 Under ether anesthesia, the abdomen was opened through a low median incision The previous abdominal scar had healed perfectly, without adhesions, the liver was normal and showed no evidence of the previous cyst, except a thin band of connective tissue extending from the upper

angle of the previous incision to the edge of the liver A permanent ventrosuspension of the uterus and a perineorrhaphy were performed Uneventful recovery, discharged on the eighteenth postoperative day

REFERENCES

[1] Ackman, F D, and Rhea, Lawrence J Non-Parasitic Cysts of the Liver Their Clinical and Pathological Aspects Brit Jour Surg, 18, 648, 1931

[2] Elkason, E L *Congenital Non-parasitic Cyst of the Liver* ANNALS OF SURGERY, 99, 691–696, April, 1934

[3] Maes, Urban Non-parasitic Cysts of the Liver Report of Two Cases Am Jour Surg, 38, 68, March, 1924

[4] McGlannon, Alex Non-parasitic Cysts of the Liver ANNALS OF SURGERY, 87, 844, 1928

[5] Muto, Masao, and Hanzawa, Shogoro Zur Kenntnis der sogenannten solitaren, waren Leberzyste Mitteilungen uber allgemeine Pathologie und Pathologische Anatomie, 6, 153, 1930

[6] Ottenheimer, Edw J, and Kinney, Kenneth Non-parasitic Cystic Disease of the Liver New England Jour Med, 200, 1093–1097, 1929

[7] Ori, Thos G, and Thurston, John A Strangulated Non-parasitic Cyst of the Liver Am Surg Phila, 86, 901–904, 1927

[8] Parry, Oliver K Congenital Cyst of Liver Jour Med Soc New Jersey, 29, 560, July, 1932

[9] Stoesser, A W, and Wangensteen, Owen H Solitary Non-parasitic Cysts of the Liver Am Jour Dis Child, 38, 241–257, 1929

PTOSED SPLEEN WITH TORSION OF PEDICLE

ELMER H ADKINS
MIAMI, FLA

A NORMAL spleen which has become displaced from its normal location in the left hypochondrium and acquired a wanderlust to varying locations in the abdominal cavity presents an interesting subject for exact causative factors and a real problem for accurate diagnosis, particularly if it occurs in the male The factors concerned in a splenoptosis, or mobility of the spleen, are both congenital and acquired In the congenital type, the length of the spleen pedicle and the conformation of the abdominal cavity are foremost The acquired factors are increased weight of the spleen and the conditions which are responsible for the relaxation of the abdominal wall and of the ligaments which support the abdominal viscera

The conditions found in the case herewith reported rather indicate that in this particular case the origin was congenital When the spleen wanders away from its normal location, it must necessarily carry with it its blood supply, and as the viscus descends, the vascular pedicle becomes correspondingly elongated, and in some cases becomes larger in diameter When the degree of mobility becomes so great that it allows of axial rotation on its pedicle, torsion occurs to a varying degree, which may result in alarming symptoms if not promptly corrected

If thrombosis of the splenic vein occurs, it also will produce symptoms of an alarming nature Displaced spleens with torsion of the pedicle rarely occur, particularly in the male, thus far, the majority of cases of this condition which have been reported have been females

Case Report—Referred by Dr A W Wallace J L B, white, male, age 25, presented himself, complaining of colicky pains in his abdomen and frequent eructations of gas On the preceding day, he had lifted a rather heavy table, and immediately afterward he was suddenly seized with severe pain in his left lower quadrant, the pain was continuous but became more severe when he attempted to stand or walk This effort would tend to "double him up" He had been nauseated but had not vomited and had experienced loss of appetite and looseness of the bowels since onset Any straining effort while at stool increased his suffering

He had formerly been a football player at college and apparently had retained the muscular "fitness" gained from his athletic experience He had suffered no illness relevant to the present complaint He had had clean appendicectomy performed two years before

Physical Examination revealed a well developed and robust young man, weight 175 pounds, height five feet ten inches He was apparently in great distress but did not feel actually ill He presented the clinical picture of a surgical abdomen There was a palpable mass in the left lower quadrant with a fair degree of overlying muscular rigidity, and marked tenderness upon pressure On account of the well developed abdominal muscles and marked contraction incident to palpation, it was difficult to outline the

mass Digital examination of the rectum revealed a smooth, tender mass, its lower edge just below the pelvic brim

Owing to the fact that the patient was not suffering acutely at this time and did not show indications of an immediate abdominal catastrophe, he was sent to St Francis Hospital for observation On admission to the hospital, his temperature was 100° F, pulse 90 Red blood cells, 4,750,000, hemoglobin (Newcomer), 87 per cent, white blood cells, 9,850, small lymphocytes, 35, polymorphonuclears, 60 per cent Kahn test for syphilis negative Uranalysis negative

On the assumption that a pathologic condition of the left half of the colon existed, a roentgenographic examination of the colon by means of barium enema, was made, which showed a moderate spasm present near the junction of the sigmoid and descending colon but no fluoroscopic evidence of any organic lesion at this site The upper, descending colon was somewhat redundant and there was one fair sized diverticulum in this region There was considerable gas in the small bowel in the region of the hepatic flexure *Roentgenologic Impression* Diverticulosis Spasm at the junction of the sigmoid and descending colon, with point tenderness which suggests diverticulitis at this site, which, however, did not permit entrance of the barium into the diverticulum *Clinical Diagnosis* Diverticulum of the sigmoid flexure with slow perforation

Operation—January 18, 1937 Under general anesthesia, a celiotomy was undertaken, through a left rectus incision, starting a little above the level of the umbilicus and extending downward for about six inches Upon entering the abdominal cavity, the first thing encountered was the very large pedicle or vascular cable which showed a one-half to three-quarter twist or torsion The spleen lay mainly in the left lower quadrant, the upper border being on a level with the umbilicus and the lower border in the pelvic cavity It was easily delivered In view of the conditions found, splenectomy seemed to be the only logical procedure and accordingly it was removed On account of the enormous size (approximately 5 cm in diameter) of the pedicle, it was not ligated en masse, the artery and vein being tied separately, close to the distal end There was no thrombosis of the splenic vein or artery

Pathologic Examination—Gross The spleen had an engorged appearance and was markedly enlarged Its weight was 575 Gm, and it measured 12 cm in length, 7 cm thick and 4 cm wide *Microscopic* Sections showed nothing of particular significance other than the engorgement There was no fluid in the abdomen Approximately 250 cc of blood drained from the engorged organ after the clamps were removed, following completion of the operation

Postoperative Course—This was rather stormy due to very marked abdominal distention and accumulation of fluids in the stomach, which necessitated stomach lavage for the first three or four days The Wangensteen method was employed After four or five days, convalescence was smooth until the eighth day postoperative, when thrombosis of the right femoral vein occurred This condition cleared up promptly, however, and delayed convalescence only two or three days

Reference to the postoperative blood findings were, however, of interest and showed

On the second postoperative day

Red blood cells, 4,670,000, hemoglobin, 87 per cent, leukocytes, 8,700

On the fifth postoperative day

Red blood cells, 4,500,000, hemoglobin, 75 per cent, leukocytes, 10,000

On the eighth postoperative day

Red blood cells, 4,440,000, hemoglobin, 74 per cent, leukocytes, 15,250, small lymphocytes, 25 per cent, polymorphonuclears, 74 per cent Blood platelets, 448,000*—on day of thrombosis

* It is rather interesting to note that femoral vein thrombosis occurred about the time of the great decrease in the number of blood platelets

On the eighteenth postoperative day

Red blood cells, 4,320,000, hemoglobin, 71 per cent, platelet count, 1,268,000

On day of discharge from hospital (February 11), when complete recovery seemed assured, final check-up showed

Red blood cells, 4,350,000, hemoglobin, 71 per cent, leukocytes, 12,000, blood platelets, 1,016,000

Only brief reference to the statistical aspect of this subject will be made A comprehensive contribution to the literature with report of two cases of wandering spleen with torsion of pedicle was published by Dr Irvin Abell, in October, 1933 In his review of the literature, he was able to collect 95 such cases in addition to the two he recorded

Included in the number of recorded cases of wandering spleen with torsion of pedicle, there occurred only five in the male Since 1933, I have found recorded six such cases, the case herewith reported making a total of 11 In 1918, Petridis reported the first splenectomy for wandering spleen in a male Pierre, also in 1919, reported a case, Southam, one, in 1921, in a boy, age six, John E Sutton, Jr, in 1925, reported the first case in America, occurring in a male, Harris of London, in 1927, one case, Eric M Fsher of Sidney, Australia, reported a case, in 1930, in a boy, age 16, J C Motley of Abingdon, Va, reported a case, in 1934, in a boy, age eight, J F Percy of Chicago, in 1933, a case in a boy, age ten, O Linden, Scandinavian surgeon, in 1934, one case, A Biondo, in 1934, a case in a male, age 30

In nearly all of the cases, the spleen has been removed Doctor Abell summarized the treatment in 95 cases recorded There were 85 splenectomies performed, with a mortality of 17 6 per cent Detortion and replacement constituted the only operation in five In patients treated by splenopexy, detortion and replacement, no follow-up as to the ultimate fate of the replaced organ is given Bland-Sutton and Conklin have each reported a case in which detortion and replacement of the organ were effected, but in each instance, acute torsion occurred

Discussion —Dr A O Singleton (Galveston, Texas) —I would like to report the case of a patient who was operated upon by me for a uterine fibroid When the pelvis was explored the spleen was found tightly packed in it It was easily removed The gallbladder was palpated and found to be acutely infected, it was drained Her elevation of temperature continued, and in about ten days she showed a positive Widal She ran a severe course of typhoid fever, but eventually recovered

Her symptoms were easily explained She had had a movable spleen with a pedicle long enough to allow it to reach the pelvis As a consequence of the typhoid infection, the spleen had enlarged enough to completely fill the pelvis The gallbladder had become inflamed from the typhoid infection with a resultant acute cholecystitis

Dr Rudolph Matas (New Orleans, La) —As pertinent to this discussion, I would like to mention an unusual complication in the course of a splenectomy on a middle aged male, who was operated upon for a very rare type of splenomegaly caused by a primary Hodgkin's disease of the Dorothy Reed type

The histology of this growth was studied by Doctor Wade [1] His report deals exclusively with the histology of the spleen, and is descriptive of a very rare example of primary splenic Hodgkin's disease, but naturally omits a feature of the operation which was very interesting to me at the time The spleen was large enough to project below the costal arch and was partially adherent to the diaphragm by recent adhesions, caused by partial axial rotation with thrombosis of the splenic vein and artery My attention was especially directed to the pancreas, which was swollen and edematous, of a pale, yellowish-white color, and the consistency of soft cheese On manipulating the spleen in order to ligate the pedicle, the tail of the pancreas, about three inches in length, tore away without any ensuing hemorrhage, holding only to the thrombosed splenic vessels, which were bloodless when ligated and cut The stump of the pancreas was also bloodless and pale, showing that the detachment of the tail had occurred in a degenerated area No ligatures or sutures were required and the stump was simply covered over with a piece of omentum There was no danger of pancreatic leakage and fat necrosis, as it was evident that necrotic process had been progressing slowly for a long time after the thrombotic occlusion of the splenic vessels had occurred The body and head of the pancreas seemed perfectly normal It was surprising, considering the length of the pancreatic fragment and its long and free exposure in the retroperitoneal cavity, that it should have escaped septic or putrefactive changes The patient made an excellent recovery and was lost sight of a month or two after the operation

The histology of the pancreatic specimen was completely destroyed in a mass of soft caseous tissue, which had resulted apparently from the thrombotic ischemia There was nothing to indicate in his preoperative history that he was suffering from glycosuria or diabetes, or any other indication of pancreatic dysfunction despite the numerous general and special examinations which had been made What relation the splenic Hodgkin's disease had with the pancreatic lesion and the splenic thrombophlebitis is a matter for conjecture

I have had a considerable experience with splenectomy for the more usual types of splenomegaly, and also one instance of a very large dislocated spleen, in an otherwise healthy woman, which had undergone strangulation because of axial rotation It had dropped into the pelvis and lay next to the uterus, to which it had become adherent, simulating a large solid ovarian tumor It was easily removed without serious consequences

REFERENCE

[1] Wade, W H Primary Hodgkin's Disease of the Spleen (Dorothy Reed Type) Jour Med Res, 29, 200–216, 1913

A COMPARISON OF THE THREE TYPES OF HYSTERECTOMY

CURTIS H TYRONE, M D

NEW ORLEANS, LA

FROM THE DEPARTMENTS OF GYNECOLOGY OF TULANE UNIVERSITY, SCHOOL OF MEDICINE OF CHARITY HOSPITAL, AND TOURO INFIRMARY, NEW ORLEANS, LA

HOSPITAL statistics show that the incidence of hysterectomy is increasing and that surgeons are extending the indications for it This is partly due to their better training in pelvic surgery and an associated improvement in preoperative and postoperative treatment, the more careful restrictions covering the use of radium in gynecology are also a factor There is, in addition, a growing realization that in dealing with a diseased uterus and its adnexa, especially during the late fourth and fifth decades, radical and not conservative measures are the best method of restoring the patient to health, as well as the best method of preventing a later train of symptoms and possible malignant changes Probably there is no organ, other than the appendix, which is so simple to extirpate On the other hand, no organ is the source of more clinical symptoms than the uterus, or the seat of more physiologic changes or pathologic processes Therefore, it should be in the first line of surgical attack

Granting, then, that hysterectomy is and should be a more popular procedure, it behooves us to review from time to time our statistics, particularly with regard to the indications and our methods of approach, and to strive constantly to improve our technic Statistics on the subject of hysterectomy have usually not included a comparison from the same clinic of the three types of hysterectomy, *i e*, the subtotal hysterectomy, complete abdominal hysterectomy, and the vaginal hysterectomy

This present report is based on 764 consecutive operations performed by the late Dr C Jeff Miller and myself during the six-year period, 1931–1936, inclusive These operations were performed upon patients admitted to our service in Charity Hospital and upon private patients in Touro Infirmary in New Orleans, and no effort has been made to distinguish between the two groups of patients in compiling these data We accepted and operated upon the ward patients, and we must consider our responsibility to them as equal to that for our private patients The ward patients more often presented a greater degree of pathology, and were usually not as good risks as the private patients, and in many instances hysterectomy was performed very reluctantly because of the extensive pathology, the condition of the patient and the failure of previous operative procedures to relieve her

The symptoms these patients presented were classic of those of pelvic pain, vesical disturbances, menstrual irregularities, and palpable tumors More than 95 per cent complained of some form of menstrual disturbance and 78 gave a history of postmenstrual bleeding

TABLE I

DISTRIBUTION OF TYPES OF HYSTERECTOMY	
Supravaginal hysterectomy	316
Complete abdominal hysterectomy	137
Vaginal hysterectomy	311

It will be noted in Table I that complete abdominal hysterectomy was performed in 20 per cent of our cases, and vaginal hysterectomy and the subtotal operation in about 40 per cent each In 54 of the subtotal cases cauterization or amputation of the cervix was performed by the vaginal route before the abdominal operation We are now performing the complete operation oftener, not only because of the danger of malignancy in the remaining stump, but because a diseased cervix produces very definite and annoying symptoms, whether the uterus is in or out of the patient The majority of the cases in which the cervix was not treated or removed were cases of extensive adnexal and parametrial infection, and we felt that the patient's chances of recovering from the operation would be definitely impaired by the performance of the complete operation In other words, a diseased cervix can later be removed from a live patient In the nullipara we do not hesitate to leave a normal cervix, and I cannot recall having later to remove it because it became the site of disease We do not believe that we shorten the vagina by our technic of complete or vaginal hysterectomy and we have not observed the so-called "dry vagina" following these operations

It will be argued, I am sure, that in accomplishing a complete hysterectomy the additional time expended is a definite contraindication to its performance I do not believe that this objection is warranted The average surgeon should not require more than five or ten minutes more to perform the complete operation in place of the subtotal In reviewing the anesthetists' charts in this series, it was found that the differences in time necessary for the performance of the three types of operation averaged only five minutes

The average age of the patient in this series of cases was 40 years The youngest patient was age 17 and the oldest 74 One hundred seventy-nine had never been pregnant and 585 had borne one or more children

The indications for hysterectomy in the series are not tabulated, as in many cases several factors were present that called for the operation In lieu of detailing the indications for operation, the appended list of the pathologic changes which were found at operation has been prepared (Table II)

Fibroids of the uterus were the indication for hysterectomy in 382 cases, about half of the total number of operations, which is considerably lower than most published statistics In six of these cases the diagnosis of sarcoma was made by the pathologist

Fibroid tumors form the chief indication for hysterectomy Removal of the uterus is the only possible procedure in multiple fibroids which in the aggregate are larger than a three months' pregnancy, in adenomyomata, in tumors associated with extensive adnexal disease, in tumors which are wedged in the pelvis, in tumors which are causing vesical disturbances, or other pres-

sure symptoms, and in tumors which are undergoing degeneration as evidenced by low grade elevations of temperature or by anemia out of all proportion to the actual blood loss

TABLE II

PATHOLOGIC CONDITIONS FOUND AT OPERATION

Pathologic Conditions	Incidence
Fibroids	382
Fibrosis and chronic metritis	238
Carcinoma of uterine fundus	29
Sarcoma of uterus	6
Pelvic endometriosis	74
Simple ovarian cysts	41
Malignancies of the ovary	11
Chronic salpingitis	153
Abscess of the ovary	39

Hysterectomy is the wisest procedure in young women with fibroids when myomectomy is contraindicated or is impossible Furthermore, it is truly conservative From the standpoint of function, irradiation is quite as irrevocable as hysterectomy and may give rise to very much more serious consequences than will follow the surgical removal of the uterus and the preservation of functioning ovaries The same considerations, it might be added, operate when intractable dysmenorrhea or menorrhagia must be handled in young women in whom conservative measures have failed to give relief

Fibrosis of the uterus and chronic metritis were pathologic findings in 238 cases These were cases in which a diseased uterus was associated with diseased adnexa or in which menstrual irregularities and pelvic pain made conservative measures inapplicable In some cases conservative therapy had been tried and had failed to give relief In 124 of these cases cervical stenosis or extensive cervical disease and previous operative procedures, such as suspension of the uterus and removal or partial removal of one or both adnexa, were additional reasons for the performance of hysterectomy

In 312 cases one or both adnexa were removed The tubes were definitely diseased in only 153 cases In 39 additional cases an abscess of one or both ovaries was found In 120 cases the adnexa were not diseased but were removed because of their disturbed blood supply associated with the very large type of fibroid tumors Routine hysterectomy in the course of salpingectomy is at least debatable If bilateral excision of the adnexa is necessary, so that the uterus would be left as a functionless organ, then its removal is justified if little or nothing is added to the risk of the operation If the uterus is intrinsically diseased, if it is so denuded during operation that adequate peritonealization is impossible, if the round ligaments are so involved in the inflammatory process that a suspension cannot be effected, then hysterectomy is indicated In nonmalignant conditions, regardless of the age of the patient, conservation of the healthy ovaries should be the aim of every surgeon We

believe that even after the menopause and until complete atrophy takes place, the ovary produces some beneficial hormone

One of the interesting findings in this study was the occurrence of pelvic endometriosis in 74 cases In some instances endometrial implants on the uterus, tubes and ovaries were merely associated with other pathologic changes, but in many instances they furnished a direct indication for the hysterectomy When endometrial implants are present to an extensive degree in the pelvis, with so much invasion of the uterine wall as to produce an enlarged fibrotic uterus, associated with pelvic pain and menstrual disturbances, hysterectomy should be performed with the preservation of one or both ovaries

Simple ovarian cysts occurred 41 times and malignancies of the ovaries in 11 cases The ovarian cysts were all large enough to produce a tumor mass palpable by the patient Hysterectomy was performed in these cases to facilitate the removal of the nonmalignant growth, and in the case of the malignant tumors of course it became an imperative procedure The removal of intraligamentary growths without serious damage to other structures of the broad ligaments is facilitated by hysterectomy

Carcinoma of the uterine fundus has always been an indication for hysterectomy, and this diagnosis was made in 29 cases of this series The complete operation is always performed and the adnexa are removed routinely

TABLE III

PERCENTAGE OF MORTALITY FOLLOWING THE VARIOUS TYPES OF HYSTERECTOMY

	No of Cases	Deaths	Percentage
Supravaginal hysterectomy	316	6	1 9
Complete abdominal hysterectomy	137	3	2 2
Vaginal hysterectomy	311	2	0 64
Entire series	764	11	1 4

Vaginal hysterectomy results in a lower mortality and its advantages far outweigh those of the abdominal route (Table III) It has a peculiarly wide field in the removal of fibroids of moderate size associated with uterine prolapse of any degree, a usefulness that is considerably greater if morcellation is employed to reduce the size of the tumor mass and so permit the delivery of a fundus larger than could otherwise be removed Vaginal hysterectomy is frequently the procedure of choice in obese and elderly women in whom postoperative complications and abdominal herniae are dangerous possibilities, as well as in patients who are poor surgical risks In procidentia or third degree prolapse of the uterus it is the only type of hysterectomy indicated, and, regardless of whether the uterus is or is not diseased, it is the operation most likely to relieve this condition The cases in which vaginal hysterectomy is performed, however, must be properly selected, and the operation must never be used when extensive adnexal disease is present

In more than half of our fatal cases peritonitis was the cause of death In all of these cases, extensive adnexal and parametrial infection was present at operation which should be evidence enough that hysterectomy is a dangerous

procedure when such infections exist However, when we further consider that we had 153 cases of extensive pelvic infection and an additional 39 cases of abscess of the ovary, our mortality does not seem too high (Table IV)

TABLE IV

CAUSES OF DEATH FOLLOWING 764 HYSTERECTOMIES

Peritonitis	6
Shock	1
Uremia	1
Cardiac	1
Pulmonary embolism	1
Pneumonia, thirteenth day	1

In the five remaining cases the causes of death were shock, uremia, cardiac disease, pulmonary embolism on the tenth day and pneumonia on the thirteenth day

I have not attempted to discuss the numerous postoperative complications or the postoperative morbidity in this series Suffice it to say that, although we had our share, the incidence was far less in operations by the vaginal route than in the abdominal type of hysterectomy (Table V)

TABLE V

CAUSES OF DEATH OCCURRING AFTER THE THREE TYPES OF HYSTERECTOMY

Supravaginal hysterectomy	
Peritonitis	4
Cardiac	1
Pulmonary embolism, tenth day	1
Complete abdominal hysterectomy	
Peritonitis	2
Uremia	1
Vaginal hysterectomy	
Shock	1
Pneumonia, thirteenth day	1

SUMMARY —(1) A series of 764 consecutive hysterectomies of all types is reported as follows Supravaginal hysterectomy, 316 cases, complete abdominal, 137 cases, and vaginal hysterectomy, 311 cases

(2) The mortality for the different types was supravaginal, 1 9 per cent, complete abdominal, 2 2 per cent, and vaginal, 0 64 per cent The mortality for the entire series was 1 4 per cent

CONCLUSIONS

Vaginal hysterectomy yields the lowest mortality, and on the basis of statistics for both morbidity and mortality, should be the operation of choice whenever it is indicated and can be performed

REFERENCES

[1] Bryan, W A, and Trabue, C C Total Hysterectomy Tr Southern Surg Assn, 48, 216, 1935

[2] Burch, L E, and Burch, J C Am Jour Obstet and Gynec, 21, 704, 1931

[3] Goodall, J R Am Jour Obstet and Gynec, 32, 628, 1936
[4] Miller, C Jeff Jour Missouri Med Assn, 29, 347–356, August, 1932
[5] Miller, C Jeff Jour Tennessee State Med Assn, 23, 201, June, 1930
[6] Rinaman, J C, and Sellers, T B Am Jour Surg, 27, 282, 1935
[7] Tyrone, Curtis H New Orleans Med and Surg Jour, 88, 490–493, 1936
[8] Tyrone, Curtis H Tr Southern Surg Assn, 1936

DISCUSSION—DR L WALLACE FRANK (Louisville, Ky) —This is a very interesting series of cases and the essayist is to be congratulated on the excellent results he has obtained A mortality of 1 4 per cent in such a series must reflect an assiduous attention to detail During the past six years, we have performed 300 hysterectomies, of which 265 were subtotal hysterectomies, 26 were panhysterectomies and 18 were vaginal hysterectomies

In the 265 cases of subtotal hysterectomy, there were two deaths, one due to postoperative intestinal obstruction and the other due to uremia The obstruction case was rather interesting in that there were no bands and no adhesions, but the mesentery of the terminal ileum was unusually long and a loop of the ileum, some two or three feet above the ileocecal valve, had slipped beneath the terminal ileum When this last part of the bowel became filled with fluid it lay across the other loop, pressing it against the brim of the pelvis, which caused the obstruction We have seen one other case of intestinal obstruction due to the same cause, and following our last case we have been extremely careful to see when the small intestine is returned to the pelvis following operation that no loop lies between the terminal ileum and the pelvic brim

Practically all of the 26 panhysterectomies were for malignant disease, there was one death in this series which was due to intestinal obstruction We do not routinely employ panhysterectomy in the treatment of myomata uteri or in pelvic infections In such conditions the reason for performing total removal of the uterus is prevention of profuse discharge and the elimination of the possible development of malignancy in the cervix which is left We have seen 10 cases of malignancy developing in the cervix anywhere from 15 months to 20 years after hysterectomy So far as we know, this has not occurred in any of the patients upon whom we have operated It has been rather definitely shown that cauterization of the cervix in cases of chronic infection reduces the likelihood of malignancy to a minimum and also prevents discharge

In the past six years we have performed 18 vaginal hysterectomies with no mortality

We attribute our low mortality not only to the careful preoperative preparation of the patient but also to the care employed in packing off the abdomen before the hysterectomy is actually begun

A SIMPLE METHOD OF CONSTRUCTING A VAGINA

REPORT OF FOUR CASES

LAWRENCE R WHARTON, M D

BALTIMORE, MD

FROM THE DEPARTMENT OF GYNECOLOGY OF THE JOHNS HOPKINS MEDICAL SCHOOL AND HOSPITAL BALTIMORE MD

IF ONE IS called upon to construct a vagina, he has at his disposal a rather wide variety of operative procedures Among them are the Baldwin[1] operation, the Popoff-Schubert operation, the use of skin grafts, prepared tubular flaps, the labia minora or the pelvic peritoneum The Baldwin operation, devised over 30 years ago, involves the use of a double loop of ileum, which is resected and drawn down through the rectovesical space The Popoff-Schubert operation uses the sigmoid in the same manner Skin grafts of many types have been used A vagina has been made of pedicle grafts prepared in the tubular form of the vagina and sutured in place The labia minora have been turned in to form the vaginal walls In a few cases, the pelvic peritoneum has been drawn down to the external genitalia to line the vagina

One should be familiar with these procedures if the question of the construction of a vagina arises, because each case is an individual problem Although each of these procedures has certain advantages, the disadvantages are so marked that they have not received general acceptance In general, they have been criticized because of the technical difficulty or magnitude of the operation, the failure to provide a vagina of adequate caliber and depth, disfigurement of the external genitalia, long hospitalization and because, in all but one, the resulting vagina is constructed of tissue which is entirely foreign to that region

One hesitates to add another operative procedure to the list which is already long Nevertheless, because the operation which I have been using is based upon a new principle, appears to be simple and quite satisfactory, I venture to call it to your attention It embodies two features which apparently have not been used previously One of these features is the principle upon which the operation is based, the other involves the use of a homely yet effective type of vaginal plug to keep the cavity open Due to these two new features, the operation is much the simplest that has yet been devised to construct the vagina, and, fortunately, has yielded excellent results

The operation is based upon the principle that the vaginal epithelium has remarkable powers of proliferation and in a relatively short time will cover a raw surface Indeed, in the fetus, the vagina is formed by the proliferation of epithelium from the urogenital sinus, a layer of epithelium that covers the external genital orifice This epithelium simply grows up around the mullerian ducts and thus forms a large part of the fetal vagina The author merely applied this principle in the adult, not knowing at the time whether

the adult epithelium retained this faculty or not Fortunately, the adult vaginal epithelium preserves this characteristic

The second new feature is the use of a plug or mold to keep the vaginal cavity open, so that the external mucosa may have an opportunity to cover the walls of the newly created space We conceived the idea that a large rubber condom, filled with some fairly firm substance, would provide a suitable mold for the future vagina (Fig 1) This is an essential feature of the new operation

Operative Technic—This is simplicity itself A common feature in all operations for the construction of the vagina is the dissection of the space between the bladder and the rectum This step in the operation can usually be finished easily in 10 or 15 minutes Into this newly created space, one introduces the vaginal mold covered by a condom, and that completes the operation

The mold is allowed to remain in the vagina for three weeks, when it is removed During this time, it requires no attention at all, except to be sure that it does not come out In none of my cases was there any evidence of infection, and, after the first day or two, there was no pain The patient is kept in bed as long as the condom is in place, after it is removed, she is allowed to go home, and returns to the office for examination, and for observation of the progress of epithelialization

Operative Details—The operative procedure is usually very easy As Baldwin said, the creation of the space between the bladder and rectum can usually be done by blunt dissection, after the incision is made in the external mucous membrane or across the dome of the rudimentary vagina One needs only to follow the plane of cleavage furnished by the fibro-areolar tissue between the layers of subvesical and perirectal fascia There is very little danger of perforating either rectum or bladder if one follows this layer In case of doubt, one can orient himself by a sound in the urethra or a finger in the rectum

One can easily perforate the bladder, however, if this plane of cleavage has been replaced by scar tissue, due to a former operation The author experienced this accident once This will be discussed in detail in the case reports

There are two rather important details to observe in preparing the vaginal space In the first place, the space must be larger than one expects it to be eventually It may contract during convalescence, it is hardly likely to enlarge The contraction may be due to slipping of the mold, to pressure of surrounding organs or to compression of the mold The vaginal space should be large in all dimensions The second item concerns hemostasis One encounters significant blood vessels usually only at two points, at the level of the broad ligament on each side These ligaments are rather resistant and may require incision in each lateral wall At this point, the vaginal vessels leave the uterine arteries and veins, and may require ligation These vessels, however, are small and do not compare with the vessels found in the normal vaginal plexus

The Vaginal Mold—It is essential to keep the vaginal space open in order that the vaginal epithelium may cover it This necessitates the use of a vaginal mold of some sort The author is quite certain that he has not yet discovered the ideal material for the mold In actual practice, condoms have been used filled with melted paraffin, balsa wood, sea sponges, and gauze sponges, other materials have also been experimented with Of all these, the melted paraffin and balsa wood molds have proved the most satisfactory

The ideal mold should be very light, so that it will not cause any pressure on surrounding organs, and firm, so that it will preserve its shape against the continual pressure of the pelvic muscles and surrounding structures Although many substances appear to satisfy these requirements, it is surprising how few will actually give good results The author finally had a set of vaginal forms made of various sizes out of balsa wood, this type of vaginal mold proved very satisfactory in the last two operations (Fig 1)

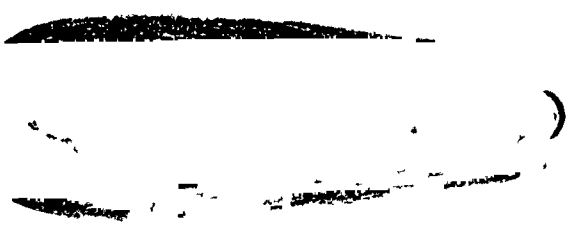


FIG 1—The vaginal mold Made of balsa wood 10 × 4 cm, by Murray Baumgartner Surgical Instrument Company of Baltimore Equally satisfactory molds can be made of melted paraffin poured into a rubber condom, or by employing a large hollow rubber tube wrapped with gauze and enclosed in a rubber condom Two thicknesses of condom are advised to cover the mold which should be light and rigid

If one uses a form made of balsa wood or paraffin, however, he must be certain that it does not compress the anterior urethra against the under surface of the symphysis pubis There is also always a certain amount of postoperative edema to be considered Urethral compression is hardly likely to occur if the form is inserted well into the vagina If, however, the patient has to wear a retention catheter because of a bladder injury, the urethra may be easily compressed In such circumstances, one should be particularly careful to have the vaginal orifice large enough and the form small enough to avoid any pressure

In only one of the four operations performed by the author was there any evidence of urethral pressure In this instance, an injury to the bladder necessitated the use of a retention catheter, the lower margin of the external urethral orifice was compressed and there was a slough of the vaginal wall of the urethra for a distance of 1 cm above the orifice This, however, caused no permanent difficulty

There have been no signs of pressure on the internal structures, the rectum or the bladder This is due, undoubtedly, to the mobility of these organs and to the lightness and smooth surface of the vaginal form

The condom mold is prepared before the operation After the condom is filled, it is tied securely with braided silk and sterilized in alcohol or other suitable solution Before introducing it, one may paint the walls of the vaginal space with mercurochrome, 5 or 10 per cent, if he wishes to do so The

condom form should be flush with the vestibule after it has been inserted The perineum must be inspected by the nurses and physicians several times daily to see that the form remains in place and that it is causing no edema or pressure changes It should not be removed for three weeks The author uses at least two thicknesses of condom around the mold, regardless of the material of which it is made

Postoperative Care—In all but one of the four operations, the postoperative course was as uncomplicated as that following a perineal repair In one instance, the bladder, however, was injured during the dissection and the patient had to wear a retention catheter for two weeks In no other case was catheterization needed The vaginal form causes no discomfort after the first two days, there was an infection in only one case, and in that case the technic was not followed strictly The patient is advised to change her position in bed frequently so that the weight of the vaginal form will be evenly distributed

The most important feature of the hospital convalescence has to do with keeping the vaginal mold in its proper place Condoms filled with sponges (either rubber, sea or gauze) contract so remarkably that they tend to slip out There has been no such difficulty with paraffin or balsa wood molds Doctor Burch made a mold of gauze sponges wrapped around a short piece of large rubber tubing and covered it with a condom It worked very satisfactorily The form should be kept in place for three weeks and the patient had better remain in bed as long as the form is being worn

The late postoperative care is just as important as that during the hospital convalescence Coitus is absolutely prohibited until at least two or three months have passed, or until the vaginal epithelium has become thick and tough One would think that it would not be necessary to give this injunction to the patient In one of my cases, however, the patient was so curious to try out her new acquisition that she disobeyed the order several times in the first week, with the result that the entire upper vault of the vagina was stripped of its new epithelium, which came out as a sheet of tissue This necessitated another operation at a later date

During the first month after leaving the hospital, the vagina is inspected several times a week in the office The process of epithelialization is watched and the surface kept clean At nighttime, a loose vaginal plug may be worn, to keep the space well dilated Care must be exercised in inserting the plug, the author advises his patients to lubricate it well with sterile albolene or olive oil The plug must also be kept clean, it should be sterilized in alcohol each time before being reinserted

Operative Results—Although the author conceived the idea of this operation and did his first case in 1928, he has refrained from publishing it until he was satisfied with the end-results, and until the operation had been successfully performed by other surgeons These conditions now seem to have

been satisfied The author has performed the operation upon two women, in one of whom the late-result is known The author also described the operation to Dr John Burch of Nashville, Tenn, and Dr Jack Hundley of Baltimore, both of whom have employed the procedure successfully The end-result in Doctor Burch's case is known

The ultimate-result in my first case is not known This patient was a pseudohermaphrodite who wanted to get married, but had found sexual life unsatisfactory because she had only a diminutive vagina The operation was entirely satisfactory as far as the immediate-result was concerned, she was examined three weeks after the operation and found to have a vagina 14½ cm deep and of satisfactory diameter She then left Baltimore but apparently has not married again In her letters, she refuses to comment upon the result of the operation, although she states that she is perfectly well and satisfied She refuses to be examined

In the second case, the final-result is excellent, as shown by the vaginogram (Fig 3) taken one year after the last operation Coitus is also satisfactory and painless, and the patient experiences a normal orgasm The vaginal walls are lined, moreover, by normal vaginal epithelium, as shown by the photomicrograph (Fig 4) of a biopsy obtained from the top of the newly constructed vagina, at the time of the last operation, two years after the second operation The type of epithelium that lines the vagina is rather important In some of the cases in which skin, peritoneum or intestine have been used, there have been disagreeable symptoms, such as a discharge, dryness and irritation Dr Hugh Young made the interesting observation that in one case in which he employed the peritoneum, a subsequent biopsy showed a metaplasia, in that the normal histologic elements of the peritoneum had changed to columnar epithelium

Discussion.—A father is proud of his sons, and a surgeon may admire his own handiwork Both are usually guilty of exaggeration Bearing this probability in mind, the operation which the author has devised seems to possess certain distinctive virtues These are its simplicity, freedom from the necessity of special dressings, shortness of hospitalization and absence of any scarring or mutilation of the external genitalia or surrounding skin In addition, the vagina becomes lined by normal vaginal epithelium, whereas, in most of the other plastic operations, it is lined by some foreign tissue, such as intestine, skin or peritoneum Finally, the resulting vagina is capacious and pliable If the first operation does not provide a vagina of satisfactory size, it can be easily enlarged subsequently If one wishes to supplement this technic by placing pinch grafts on some area not covered, it can be attempted If, for any reason, the procedure devised should fail completely, no damage has been done, and one still has the option of performing any of the other more complicated types of operation, if he wishes to do so In actual practice, the vagina constructed by this technic is normal in its characteristics, in the last case, it has become 1 cm deeper during the last year, due to intercourse

The Limitations of the New Operation—Since the vaginal space is lined by epithelium which proliferates from the vestibule or the rudimentary vagina, it would seem that this operation would be feasible only when there is some vaginal epithelium to start with We do not know whether the epithelium of the labia minora would proliferate as the vaginal mucosa does We would hesitate to recommend this operation, however, when there is complete absence of any mucous membrane, with aplasia of the labia minora or vestibule In both of my cases, there was a rudimentary vagina, so shallow that it flattened out completely when the labia minora were separated under tension, but furnishing enough epithelium for proliferation

CASE REPORTS

Case 1—No 11301 An hermaphrodite, white, age 26, was admitted to the Union Memorial Hospital, November 10, 1926 She had been raised as a girl At the age of 16, she was told by her father that she would have to shave or leave home At age 18, she fell in love with a man She had normal sexual desires and was attracted only to men Since she herself was really a man but did not know it, she was exclusively, but innocently, homosexual During sexual excitement, she noted the presence of a penis which was about three or four inches long and which would become erect This was removed by a surgeon in Massachusetts, in 1918 At the same time, he removed a normal looking testicle from each groin

The patient married at the age of 20, and lived with her husband for two years She is under the impression that her husband never suspected that she was an hermaphrodite and really a male They separated, however, after two years of married life She then became a nurse and held responsible positions Later, she contracted syphilis and came to Baltimore to see Dr Earle Moore, in 1926, to have the sexual problem settled and be treated for her syphilis She also expressed her intention to marry again

Physical Examination—There were distinct evidences of masculinity, although her general reactions and behavior were those of a woman The patient was highly intelligent, cooperative and of pleasing manners She was rather stocky The voice was distinctly contralto, yet not so harsh as a man's The neck was short and heavy, the hands were larger than a woman's The upper lip showed a slight hypertrichosis There was little if any palpable glandular tissue in the breasts The crines pubis were transverse

Gynecologic Examination—The labia majora and minora were distinctly smaller than usual The urethra was normal The clitoris had been amputated The vaginal orifice was so small that it admitted only one finger, and the vaginal cavity was 4 cm deep and ended blindly

The problem of syphilis was handled by Doctor Moore and, until February 1928, we held in abeyance the question as to whether or not we would advise the construction of a vagina At that time, she returned to see whether a vagina could be made Dr Staige Davis was consulted and it was decided that the situation warranted an attempt to give her normal sexual life It was our intention to try to utilize the labia minora as flaps, but since these proved to be too small, it was decided to employ the operation which I had been thinking about and had planned

Operation—April 5, 1928 The vaginal cavity was then dissected out as has been described, and the condom placed in position While making the vaginal dissection, a cavity or sac was encountered in the areolar tissue between the bladder and rectum

This was about 4 cm above the dome of the rudimentary vagina and measured about 1 cm in diameter It was apparently lined by some type of thin epithelium This was an embryolic vestige of unknown origin The same situation was found in Case 4, from which biopsies were taken The vaginal orifice was also enlarged by a plastic operation,

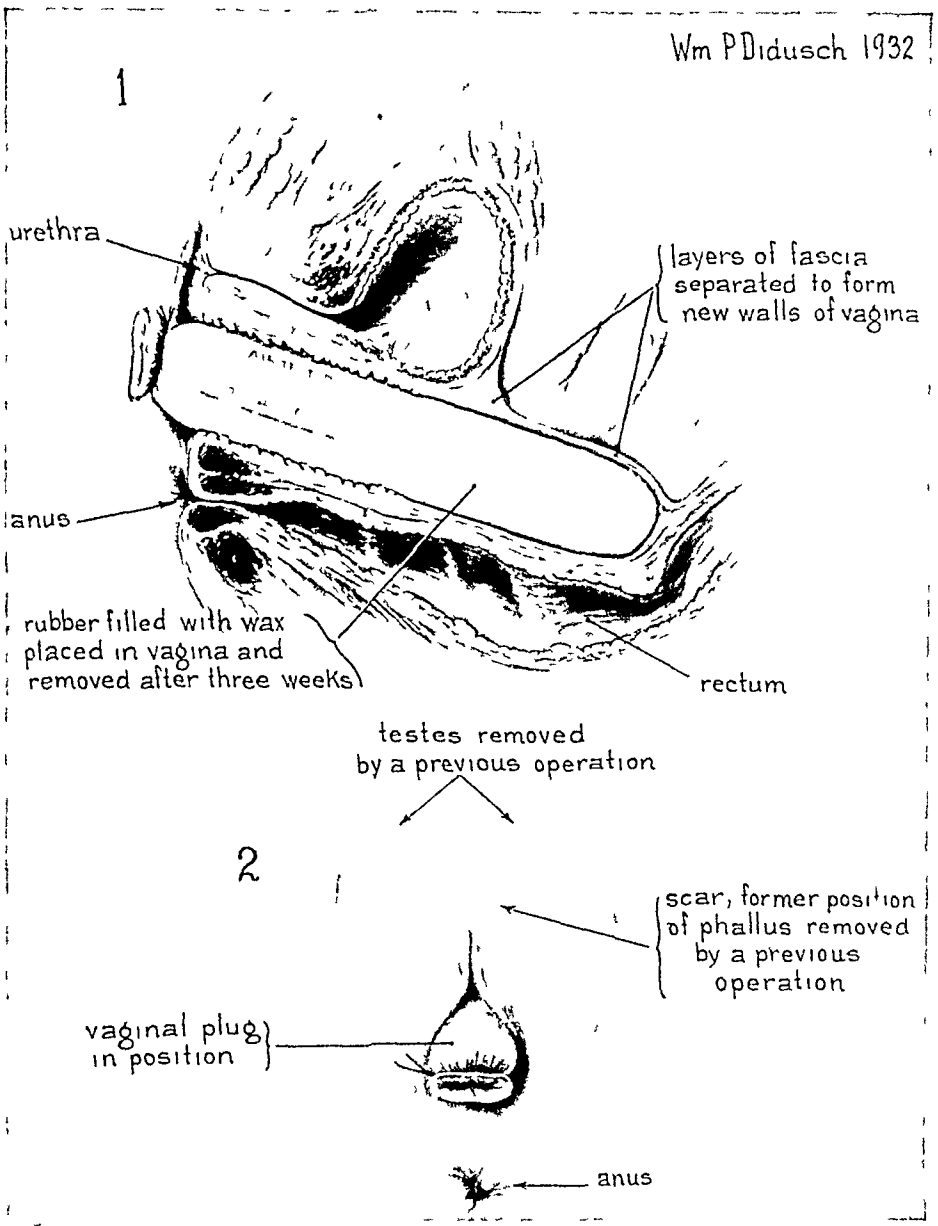


Fig 2.—The Operation Case 1 The vaginal space has been dissected and the vaginal mold has been placed in position The artist has allowed the mold to protrude more than it should from the external orifice It should be so placed that the labia fall over it easily (Reproduced by Courtesy of Dr Hugh H Young and Williams & Wilkins Co Baltimore Fig 192 p 285 Hugh H Young Genital Abnormalities Hermaphroditism and Related Adrenal Diseases Williams & Wilkins Co, Balt 1937)

employing a procedure exactly the opposite of that used to effect a perineal repair (Fig 2)

An exploratory celiotomy was then performed, to determine the sex status No uterus, tubes or ovaries were found There was complete aplasia of the mullerian ducts The only sexual organ in the pelvis was a rudimentary structure resembling the vas

deferens, which started near the base of the bladder, ran across the floor of the left half of the pelvis and up to the left inguinal ring There was no similar structure on the right side The vaginal mold could be easily seen under the bladder, causing a slight prominence of the cul-de-sac of Douglas

Subsequent Course—On April 23, 18 days later, in consultation with Dr Staige Davis, a special examination was made The vaginal mold was removed It had caused no discomfort whatever, and the convalescence had been normal In the knee-chest position, we examined the vagina with a large vaginal speculum It ballooned out normally It was smooth and appeared to be lined by a thin epithelium A biopsy was not taken as we expected to see the patient again The vaginal plug was again inserted, after it had been sterilized, and after the vaginal walls had been painted with 2 per cent mercurochrome The vagina measured between 14 and 15 cm in depth

That was the last time, however, that we saw this patient We have heard from her at times, although she answers letters reluctantly She lives in New England, says she is happy and well, but makes no mention of her sexual life She has not married again Much as we were pleased with the immediate result of this new operation, I hesitated to publish it formally until we knew what the end-result would be In 1933, however, we were glad to have Dr Hugh Young[2] include this case in an address on hermaphroditism and a report of it was published, with a brief note concerning the technic of the operation He also described the case and the operation in greater detail, in 1937, in his book on "Hermaphroditism"

Case 2—Age 30 Examined first in January, 1934 She appeared to be a perfectly healthy young woman, whose only physical defect lay in the development of the mullerian ducts She complained of inability to have satisfactory sexual intercourse

She had, however, been happily married for several years Before marrying, she told her fiance that she could not have children, as she had never menstruated She did not know, however, that she had an almost complete absence of the vagina She consulted me to find out whether it would be possible to make a normal vagina for her

Fortunately, in 1928, an appendicectomy had been performed, at which time the surgeon had explored the pelvis thoroughly through a right rectus incision The mullerian ducts were separate, each terminating medially in a small body the size of a thimble From this olive shaped mass on each side, a rudimentary fallopian tube ran off laterally, to end in a well developed, though diminutive fimbria The ovaries were perfectly normal

Physical Examination revealed that the external genitalia were normally formed, of usual size and development The vaginal orifice was of normal size The vagina, however, consisted of a shallow depression which flattened out completely when the walls of the vestibule were stretched laterally The rudimentary vagina admitted only one finger to a depth of 3 cm

The problem was thoroughly discussed with the patient The situation certainly warranted the construction of a vagina, if it could be accomplished She had heard of our apparent success in the first case and desired to have the attempt made

Operation—March 3, 1934 A vaginal space was created by the usual procedure, fully as large or larger than a normal vagina The vaginal mold, made of melted paraffin poured into a condom, was then placed in position

Subsequent Course—Two weeks later, the patient became rather hysterical and said she was sure that the vaginal plug was going to perforate the rectum As she was a graduate nurse, and since her husband also became insistent, the vaginal mold was removed on the fourteenth day, it being my intention to replace it with a condom stuffed with gauze sponges Unfortunately, the rubber condom broke as it was being removed, and the paraffin crumbled into many small fragments The patient had to be anesthetized and the pieces taken out one by one Following this, a smaller plug made of a condom full of gauze sponges was placed The patient left the hospital three days later, and came to the office for examination three weeks after the first operation was done

This operation did not provide as deep a vagina as was desired, the second plug could not be placed as satisfactorily as the first, and the upper end of the vagina had contracted before it was covered with epithelium It was, moreover, too sensitive to dilate The result of the operation was, however, that the vagina had been widened, and was now about 5 cm in depth

Second Operation—Because of the misadventure following the first procedure, a second operation was performed, December 28, 1934 (a ten-month interval) The surgical dissection was repeated easily The convalescence was normal The patient left the hospital three and one-half weeks postoperative Ten days after she went home she disobeyed injunctions and had sexual intercourse Penetration was normal, and an orgasm was experienced This was repeated several times during that week, with the



Fig 3—Follow Up Study, Case 2 Vaginogram one year after last operation Vagina measures nine centimeters in depth and is of normal caliber The condom has been filled with barium

result that the newly formed epithelium was torn away and cast out as a sheet of tissue This, however, did not entirely defeat the result of the operation, as the vagina was approximately 2 cm deeper than before the second procedure

The patient returned in December, 1936, two years later, determined to have another addition to the vagina I was rather disgusted with the situation, because we had twice made a satisfactory vagina, and each time had been disappointed, once by our inexperience in using only a single layer of rubber condom and the hysteria of the patient, and the second time by the patient's uncontrolled libido

Third Operation—December 20, 1936 Johns Hopkins Hospital, No 76252 This time, the operation was made more difficult, due to scar formation The dissection went along smoothly, however, and just as we were about to stop, it was decided to add another centimeter or two to the space This final effort led to a perforation of the bladder This opening was closed, a retention catheter inserted and a vaginal mold made of balsa wood placed in position The convalescence was uneventful

Follow-Up—The late-result has been extremely gratifying, as the vaginogram shows (Fig 3) Coitus is perfectly normal The vagina is 9 cm deep above the vestibule, and is capacious The patient experiences a normal orgasm She is quite certain, however, that the vagina is not as deep as it was immediately after the second operation, the result of which was partly nullified by premature sexual intercourse The vesicovaginal fistula is almost completely closed, at times, there is no leakage for several days, when present, it is very slight The fistulous opening must, apparently, be very small The vagina is lined by normal vaginal epithelium (Fig 4)

Three years ago, during an informal conversation, I happened to mention to Doctor Burch the operation I had just performed on the second case in this series He stated that he was facing the same problem in one of his patients, and thought he would try the operation I had devised With his permission, I am publishing the report of his case and the illustrations



Fig 4—Case 2 Photomicrograph of a biopsy specimen from the highest point (seven centimeters above the vaginal orifice) of the constructed vagina, two years after the second operation This shows normal adult vaginal mucosa The stratum germinativum has the usual characteristics staining deeply the cells and their nuclei are arranged normally The vaginal mucosa is deep, as in a woman with normal ovarian function There is a thin layer of cornified epithelium on the surface In the subjacent tissue, one sees no evidence of inflammation The vascularity is normal The entire constructed vagina was lined by this tissue (Union Mem'l Hosp, Path No 10,276)

Case 3—Vanderbilt Hospital, No 80866 Published by courtesy of Dr John Burch, Nashville, Tenn A white female, single, age 18, was admitted to the Vanderbilt Hospital, in September, 1936, with the history of never having menstruated At the age of 15, she had cramps in the lower abdomen at monthly intervals, lasting one or two days

Physical Examination was essentially negative except for the pelvis The pubic hair was normal in amount and distribution The labia majora and minora were normal A thick, loose membrane covered the site of the vaginal orifice The vagina was entirely absent A small, indefinite mass was felt in the region normally occupied by the cervix

Operation—September 16, 1936 Vaginal cavity prepared chiefly by blunt dissection, after the initial incision of the external, obstructing membrane Artificial canal thoroughly stretched Cavity packed tightly with wick drains Retention catheter placed in bladder Temperature, 102° F, until the fifth day, when the wick drains were removed A vaginal mold, made of rubber tubing wrapped with gauze and covered by a rubber condom was then placed in position Two days later, this was expelled, followed by the discharge of a large amount of pus The cavity was thoroughly irrigated, 5 per cent mercurochrome instilled, and the vaginal mold (condom) was replaced The temperature fell satisfactorily The vaginal mold was kept in place until the twenty-second day The patient was walking on the twenty-eighth day and discharged on the thirty-second day postoperatively

Follow-Up—A pneumoperitoneogram, six months later, showed no uterine shadow Nine months after operation, the vaginal cavity was 8 to 10 cm deep (Figs 5 and 6) The patient has normal intercourse

Case 4—University Hospital, Baltimore, Md Published by courtesy of Dr J

Mason Hundley, Jr, Baltimore, Md A white, pseudohermaphrodite of masculine type, age 26, presented himself for examination at the University Hospital in October, 1937 The patient had been raised as a woman, shaving was frequently necessary

Physical Examination showed a general bodily configuration of masculine type, resembling somewhat Case 1, there was a marked general hypertrichosis of the body, the clitoris was hypertrophied, there was a small testicle in each inguinal canal, the labia majora and minora were normal There was, apparently, no vagina present, a membrane covering over the site of its normal orifice

During an examination, November 4, 1937, this membrane was easily ruptured by the index finger, which was then insinuated, by blunt dissection, into tissues between the urethra and rectum A small cavity was found, similar to that found in Case 1 There was moderate bleeding



FIG 5—Case 3 Photograph showing the resultant vaginal orifice nine months after operation (Courtesy of Dr John Burch)



FIG 6—Case 3 Photograph showing the intravaginal condition nine months after operation A vaginal speculum can be easily introduced The vagina measures nine centimeters in depth and has a normal caliber (Courtesy of Dr John Burch)

Operation—November 10, 1937 Construction of vagina, amputation of clitoris, and an exploratory celiotomy by Doctor Hundley at the University Hospital, Baltimore, Md The vaginal space, partially excavated six days previously, was enlarged The narrow vaginal orifice was enlarged by two lateral incisions which bled rather freely The mucous membrane and skin were approximated as in Case 1 The small cavity which had been found under the posterior urethra appeared to have some type of lining membrane A balsa wood mold was then placed in position, and covered with two layers of rubber condom At the exploratory celiotomy no sex organs were found in the pelvis except a bilateral, rudimentary structure resembling the vas deferens, a structure similar to that noted in Case 1 No ovaries, tubes or uterus A small testis was found in each inguinal canal With the abdomen open, the vaginal form could be seen covered only by peritoneum, below the bladder There was a slight tear of the peritoneum over the vaginal mold, consequently, a cigarette drain was placed in the abdominal incision Convalescence was uneventful The biopsies taken from the wall of the embryonic space in the recto-urethral septum showed squamous cell epithelium A further report of this case will be made in greater detail at a later date

SUMMARY OF CASE REPORTS

The Operation and Convalescence—In Case 1, the operation and convalescence were entirely uncomplicated, the immediate result (one month later) was excellent In Case 2, three operations were performed, for reasons stated In the last operation, the bladder was accidentally opened The patient still has a very small fistula, as there is occasionally a little leakage, although it is completely dry part of the time In Case 3, there was a postoperative infection of the vaginal space In this case, however, the recommended technic was not followed, as uncovered gauze wicks were used instead of a smooth condom mold The infection disappeared two days after the gauze packs were replaced by the condom mold In Case 4, there was definitely more bleeding from the lateral vaginal incisions than one obtains following a single median perineal incision This step, however, was necessary, as in Case 1, to enlarge the vaginal orifice This is also the only case in which the peritoneum was perforated while preparing the vaginal space It caused no complication, and was discovered by chance during the exploratory celiotomy performed to determine the sex status

The Ultimate Results—In two of these four cases, deep and satisfactory vaginas have been formed, as shown by follow-up examinations, nine months and one year after operation Coitus is normal, with resultant orgasm, in both cases In two cases, the late-result is unknown, one patient having been operated upon very recently, the other being unwilling to discuss her sexual life by mail

Although the operative technic is simple, it is evident that difficulties have been encountered even in the hands of experienced gynecologists The convalescence should also be observed carefully

CONCLUSIONS

A new operation for constructing the vagina is presented It is based upon a principle which had not been appreciated before, namely, the remarkable ability of the vaginal epithelium to proliferate and cover raw surfaces This is essentially the manner in which the vagina develops in the fetus The operation merely attempts to reproduce, in a way, the conditions under which the fetal vagina develops Another new feature is the use of a vaginal mold, in a smooth, sterile condom, in order to keep the space open and allow the squamous epithelium to cover the vaginal walls

The operation would appear to have certain definite advantages It is simple of execution The convalescence is usually smooth No complicated or painful dressings are necessary It does not involve the highly technical and complicated stages of plastic operations There is no disfigurement or scarring of the external genitalia The period of hospitalization is short The constructed vagina is deep and capacious, and is lined by normal vaginal epithelium, instead of some foreign tissue, such as intestine, skin or peritoneum

REFERENCES

[1] Baldwin, J F The Baldwin Operation for the Formation of an Artificial Vagina Surg, Gynec, and Obstet, 45, 569–570, July–December, 1927

[2] Young, Hugh H Some Hermaphrodites I Have Met New England Jour Med, 209, 8, 370–374, April 24, 1933

[3] Young, Hugh H Genital Abnormalities, Hermaphroditism and Related Adrenal Diseases 649 pages Williams & Wilkins Co, Baltimore, 1937, pp 280–287

DISCUSSION —DR LLOYD NOLAND (Fairfield, Ala) —I would like to ask Doctor Wharton how long the vaginal plug is allowed to remain in position before its first removal? How frequently is it removed for cleansing, and has he had trouble with secondary hemorrhages following the removal of the plug? We have tried somewhat the same technic, using a hard rubber rectal bougie, and on two occasions were confronted with severe bleeding following removal

DR LAWRENCE R WHARTON (closing) —The questions that have been asked concern two features of the technic First, the length of time that the form is kept in the vagina, and second, the matter of bleeding and infection

I have arbitrarily left the form in place for three weeks After some of these operations, the patient has continued to wear the form at home at night for a month or so These patients seem to have no better final result than those who did not replace the form at all, after having worn it three weeks This is a matter for further observation

We have had no trouble with bleeding, although in the case operated upon by Doctor Hundley there was considerable bleeding during the operation This was due, I believe, to two things The vaginal space had been partly dissected out only five or six days previously, causing hyperemia, and second, the vaginal orifice was enlarged by two lateral paravaginal incisions, resembling superficial Schuchart incisions Lateral incisions through the perineum and labia always bleed more profusely than a single median incision There is no reason for any such external incision, unless the vaginal orifice is very small

The only site that requires hemostasis in the dissection of the vaginal space is on each side, where the broad ligaments are attached Here one encounters the uterine plexus and the origin of the vaginal veins and arteries Of course, in these cases, these vessels and plexuses are much smaller than in women who have normal uteri and vaginae Even in these cases of absence of uterus and vagina, however, one finds these vessels, and they require ligation

In my own cases, there have been no infections, except in one instance, and this apparently resulted because my technic was not followed strictly Dry gauze had been used to pack the vagina This was removed on the fifth day, when the temperature reached 102° F A plug covered with a smooth rubber condom was then inserted, and in three days the temperature had returned to normal

There are ordinarily no difficulties encountered in dissecting the space for the vagina, if one follows the plane of cleavage But if one has to dissect such a space in a patient who has been operated upon before, he finds that scar tissue has replaced the loose areolar tissue and the plane of cleavage has largely disappeared In one such case a small hole in the bladder resulted

I appreciate the comments of those who discussed this operation This is apparently a new procedure, without any precedent, and we do not present it as a finished product We hope to improve the technic as future cases are operated upon I am also certain that the type of vaginal mold will be improved

POSTERIOR VAGINAL HERNIA

WILLIAM T BLACK, M D

MEMPHIS, TENN

FROM THE DEPARTMENT OF GYNECOLOGY, COLLEGE OF MEDICINE, UNIVERSITY OF TENNESSEE, MEMPHIS, TENN

TRUE posterior vaginal hernia, judging by reports in the literature, is of rare occurrence Garengeot probably was the first to describe this condition, in 1736 Not until 1804 was another case reported, its discoverer being Sir Astley Cooper Thomas, in 1885, reviewed the literature on the subject and presented a personal case In 1922, Chase[3] made a comprehensive review of levator hernias, and Miles,[8] in 1926, and Bueermann[1] and Masson,[6] in 1932, gave us complete résumés of pelvic hernias

In 1933, the writer described a case of posterior vaginal hernia before the Central States Association of Obstetricians and Gynecologists The patient in question had sustained a fall, which was followed by severe pain and impaired function in the rectovaginal region No doubt, the hernia had existed previously, but it was unrecognized until disability developed from the fall

Reports of five additional cases of this type of hernia have been made since 1933 two by Dew,[4] one by Stearns,[9] one by Huet,[5] and one by Caillot, Rochet, and Contamin[2] The author is herein reporting two other cases, making a total of 67 recorded to date

True posterior vaginal hernia should not be confused with pseudohernia, or rectocele, in true posterior vaginal hernia a definite sac, as in inguinal hernia, is present Nor is it identical with operative vaginal hernia or anterior or pudendal hernia It is quite likely that posterior vaginal hernia, as discussed here, is frequently overlooked, no doubt, unexplained complications from labor, trauma, and perineoplasties might be found, upon investigation, to be caused by this condition

Case 1—A D, white, female, married, age 50, was admitted to the John Gaston Hospital April 17, 1935, complaining of a "fallen womb," and stated that she had first noticed a protrusion from the vagina seven years earlier The mass had gradually increased in size She was suffering some pain and was troubled with constipation, but had no other symptoms

The patient was the mother of two children, the youngest age 21 Delivery and the puerperium were uneventful following both pregnancies She had had no abortions Menstruation has always been normal, and she had never had leukorrhea She was well developed, even slightly obese, and apparently not acutely ill

Physical Examination revealed nothing of significance No abnormality could be found about the head, neck, heart, lungs, abdomen, or extremities Blood pressure 152/78 A study of the blood showed red blood cells, 4,700,000, white blood cells, 11,500, hemoglobin, 95 per cent, polymorphonuclears, 65 per cent, lymphocytes, 35 per cent Urea nitrogen, 13 mg , sedimentation rate, 18 Mm in 60 minutes, Wassermann reaction, negative Urine, normal

On pelvic examination the uterus was found to be completely prolapsed and the mucosal folds of the vagina hypertrophied The cervix was atrophic The perineum was markedly relaxed, both a large rectocele and cystocele were present

Operation—A vaginal hysterectomy, anterior colporrhaphy, and perineorrhaphy were performed April 22, 1935 Recovery was uninterrupted

Pathologic Examination—"The specimen consists of the uterus, cervix, and a portion of the vaginal wall The uterus is slightly enlarged and contains a few small myomata The cervical canal is greatly elongated, measuring 7 cm in length Diagnosis Multiple fibromyomata of the uterus"

Subsequent Course—The patient returned August 8, 1935, complaining of a bulging in the vagina Following her previous dismissal, after having been up and about, she had noticed that upon straining, especially at defecation, there was still a protrusion from the vagina This had gradually enlarged and had been a source of constant discomfort The only noteworthy finding on general physical examination was a blood pressure of 182/90 Laboratory data showed no abnormality

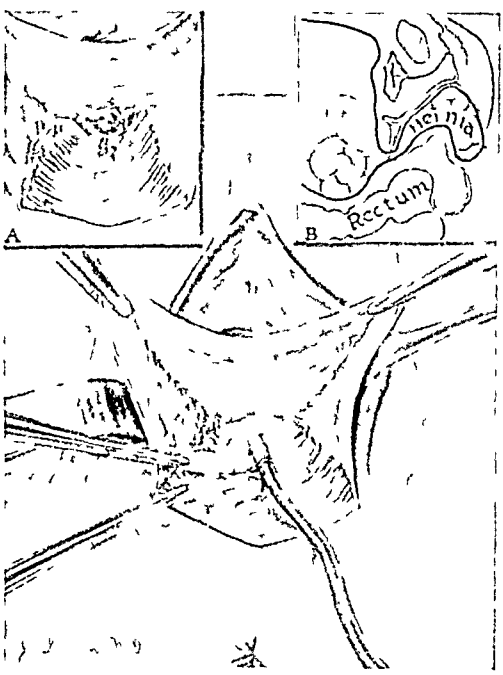


FIG 1—Case 1 Drawing shows intact peritoneum with sac freed from neighboring scar tissue Probe inserted into torn peritoneal cavity Insert A shows stump of sac sutured to vagina and ligaments Lower four sutures close space through which hernia protrudes Insert B is a diagrammatic representation of the formation and protrusion of peritoneal hernia

Pelvic Examination disclosed an excellent result from the hysterectomy, anterior colporrhaphy, and perineorrhaphy, the floor of the perineum was firm and the bladder well supported When the patient strained down, however, the posterior vaginal wall was extruded from the vagina about three inches Rectovaginal palpation gave a sense of borborygmi to the examining fingers A hernia was suspected The patient was discharged August 24, 1935, after several ineffectual attempts had been made to insert a pessary for support She was readmitted September 9, 1935, at which time nothing additional was found on physical eamination

Operation—September 11, 1935 An incision was made at the vaginal mucocutaneous juncture, and the vaginal mucous membrane was dissected upward A peritoneal sac was demonstrated between the vagina and rectum Because of the extensive scar tissue formation and adhesions, the sac was freed with difficulty, during which manipulation it was torn The lumen was finally located quite high, and was ligated and sutured to the upper part of the vagina, and the round and broad ligaments (Fig 1)

The patient was discharged on the fifteenth postoperative day A subsequent examination revealed an excellent result

Case 2—S L, colored, female, age 36, was admitted to the John Gaston Hospital February 1, 1937 She had been married 14 years and had never become pregnant She denied having had venereal disease The menstrual history had been normal until three months previously, since which time the periods had appeared every 14 days She had been troubled for one year with a rather severe nocturia and an occasional pain and burning on urination, as well as with a leukorrheal discharge Her chief complaint, which had also developed a year earlier, was a tendency to prolapse of the uterus The parts could be replaced by external pressure through the vagina She had had an annoying itching about the genitalia, but had suffered no pain or soreness until the preceding week, when an aching pain began in the lower abdomen At the same time, she had noticed a small white growth on the surface of the prolapsed part

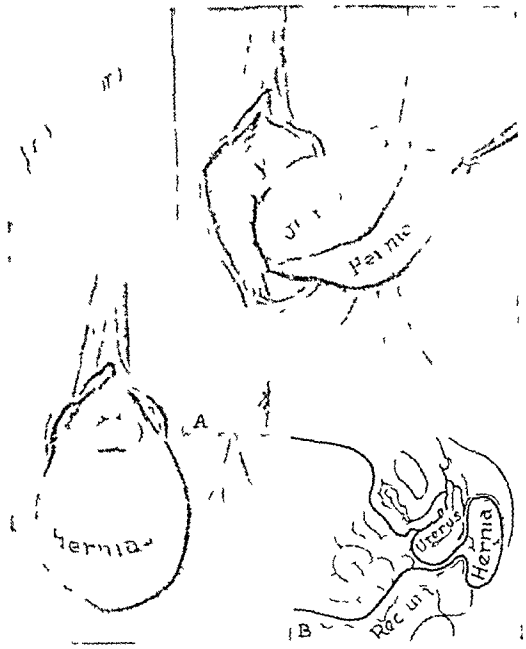


FIG 2—Case 2 Drawing shows clinical appearance of posterior vaginal hernia with cervix of prolapsed uterus Insert A shows the vaginal mucosa enclosing the sac being drawn forward together with the prolapsed uterus The perineum is normal, the patient never having been pregnant Insert B is a diagram illustrating the formation of a peritoneal sac and prolapsed uterus

Physical Examination of the eyes, ears, nose, and throat were negative The teeth were in poor condition Blood pressure, 122/80, red blood cells, 4,330,000, white blood cells, 6,150, hemoglobin, 14 Gm , polymorphonuclears, 54 per cent, eosinophiles, 1 per cent, lymphocytes, 44 per cent, and mononuclears, 1 per cent Sedimentation rate, 18 Mm in 90 minutes, Kahn reaction, negative The urine contained three to six pus cells per high power field, but was otherwise negative

Pelvic Examination showed the perineum markedly relaxed and the vulva gaping, revealing, apparently, a large rectocele, with a small area of cornification on the mucosal surface The cervix was clean and well epithelialized, of the nulliparous type The uterus was enlarged to the size of a two months pregnancy, freely movable and firm, a small fibroid was found on its anterior wall There was a prolapse through the introitus when the patient strained The ovaries were slightly enlarged and tender Rectal examination was negative With a finger in the rectum and another in the vagina, one could palpate the mass, it appeared to be filled with gas, which was easily displaced by pressure

Diagnosis—Posterior vaginal hernia, second degree uterine prolapse, and myomata of the uterus

Operation—February 7 A vaginal hysterectomy and posterior vaginal herniotomy were performed The peritoneum extended down to the perineum, the perineal body was retracted and the peritoneum dissected free, excised, ligated, and sutured to the vagina, and round and broad ligaments (Fig 2)

Pathologic Report—Fibromyomata of the uterus, chronic cervicitis, and ulceration of the vaginal mucosa

The patient was discharged on the eighteenth day postoperative She returned later for examination and was found to have a good result

Etiology—The primary etiologic factor in the development of a posterior vaginal hernia is a congenital defect there being, apparently, an imperfect or entire lack of fusion between the rectum and vagina, and, in addition, a congenital low peritoneum with a weakening of the pelvic floor Upon this may be, and often is, superimposed a secondary force which causes these primarily weakened tissues to separate still further If fusion is at fault, the straining of labor, or an increased intra-abdominal pressure from an abdominal tumor or fluid, may permit descent of the peritoneum and viscera through this area A congenital reflection of the peritoneum down to the perineum has been found in a few postmortem examinations The congenital weakness of the pelvic floor and low peritoneal misplacement seems to be the most plausible explanation for the occurrence of posterior vaginal herniae in nullipara The point of descent is usually through the median line of the pelvis, which is the weakest part According to Symington, the mesial plane of the pelvis is 2 5 cm thick, whereas laterally it is 5 to 7 cm in thickness The hernial ring is generally formed between the uterus anteriorly, the sigmoid-rectum posteriorly, and the sacro-uterine ligaments laterally

Symptoms and Diagnosis—The symptoms of an uncomplicated posterior vaginal hernia do not differ in type from those of rectocele, although they are, as a rule, more pronounced Following rupture, an incision, or other trauma, the symptoms become severe

Posterior vaginal hernia must be differentiated from vaginal cyst and other tumors, rectocele and cystocele Vaginal cysts do not increase in size with coughing or straining, nor do they often empty on pressure, however, a congenital cyst of the ampulla of Gartner's duct, at the upper anterior surface of the vagina, does at times empty its contents through the duct into a cyst of the parovarium in the broad ligaments If the hernia points to the perineum or ischiorectal fossae, a distinction from other tumor formations will be necessary An operation for repair of a rectocele should never be undertaken without an examination for a hernial sac, otherwise, serious mistakes might occur The protruding mass might return, with disappointment to the patient and embarrassment to the surgeon To make the differentiation, one should bear in mind that a rectocele, when examined per rectum, does not enter the protruding mass When an intestine occupies the hernial sac, a gurgling sound may be heard upon palpation with one finger in the rectum and the other in the vagina A soft mass will be observed if the omentum is present If fluid

fills the sac, it readily disappears upon pressure or upon placing the patient in the Trendelenburg position The contents of a posterior vaginal hernia usually disappear when the patient is in a recumbent position only to return when an upright position is resumed A roentgenogram following the ingestion of barium may be of service in the diagnosis if a loop of intestine is located in the hernia Peristalsis may be observed at times A peritoneal sac encountered at operation or autopsy is positive evidence of a true hernia

Complications—The number of complications which may attend posterior vaginal hernia can well be appreciated by a study of Bueermann's[1] report of 59 cases

(1) Interference with normal delivery, ten cases

(2) Hernia incised or excised due to error in diagnosis, with death, three cases

(3) Pelvic abscess following delivery with spontaneous recovery, two cases

(4) Rupture of hernia with evisceration and death, two cases

(5) Rupture of hernia with recovery, one case

(6) Death from incarceration of vaginal hernia, one case

From the above, it is apparent that lacerations at childbirth, accident during operations, perforation, strangulation, and rupture from trauma or severe straining are dangerous potentialities in this condition

Treatment—The treatment of posterior vaginal hernia is surgical If the opening into the peritoneal cavity is small, the principles observed in other hernia operations are sufficient to effect repair However, a better result may be obtained by fixation of the stump to the posterior surface of the uterus, or, if an hysterectomy has been performed, to the vault of the vagina and ligaments A celiotomy is advisable if the hernial opening is large, or there is any pathology in the pelvis, such as a large uterine tumor, in this event, the sac is freed from below and inverted into the pelvic cavity, and the stump sutured to the uterus Celiotomy is also indicated when the intestine has ruptured or has been punctured, and the loop of intestine has reentered the pelvic cavity If a perineal laceration is present, a high perineorrhaphy should be performed It was not necessary to enter the peritoneal cavity from above in the author's three cases

SUMMARY

Three cases of posterior vaginal hernia have been observed In the first case, reported in 1933, the patient was a white woman, age 65, and the mother of seven children She sustained a hard fall, which caused severe rectovaginal pain and necessitated her confinement to bed until she was relieved by operation

Case 1, reported in the present article, was that of a white woman, age 50, and the mother of two children She was successfully operated upon for procidentia, a large cystocele, and a lacerated perineum Upon her return for examination, a bulging of the posterior vaginal wall was discovered Four

months later, she reentered the hospital for removal of a mass which protruded through the vaginal orifice This mass proved to be a posterior vaginal hernia The sac was adherent from scar tissue formation consequent to the previous operation

In Case 2, the patient was a colored woman, age 36, who, although having been married 14 years, had never become pregnant She was treated surgically for uterine prolapse, a relaxed perineum, and a large mass, congenital in origin, which protruded from the posterior vaginal wall through the vaginal orifice

Less than 70 cases of posterior vaginal hernia have been reported in the literature

Primarily, the cause is a congenital defect in development, *i e*, a congenitally low reflection of the peritoneum with improper fusion of the rectum and vagina, and a weakness of the pelvic structures in this region

Posterior vaginal hernia may be a source of grave trouble in childbirth, traumatic injury, and in the performance of perineoplasty, and may be responsible for an unsuccessful outcome of perineoplasty

REFERENCES

[1] Bueermann, W H Vaginal Enterocele J A M A, 99, 1138, 1932
[2] Caillot, J, Rochet, E, and Contamin, R Un cas de perforation apres curage du culdesac vaginal posterieur, avec issue du colon sigmoide, traitee par l'hysterectomie abdominale totale Bull Soc de Obst et de Gynec, 24, 478, 1935
[3] Chase, H C Levator Hernia (Pudendal Hernia) Surg, Gynec, and Obstet, 35, 717, 1922
[4] Dew, J H Posterior Vaginal Hernia Jour Georgia Med Assn, 23, 349, 1934
[5] Huet Intestinal Rupture in Posterior Vaginal Hernia Bull et mem Soc nat de Chir, 60, 936, 1934
[6] Masson, J C Prolapse, Cystocele, Rectocele, and True Vaginal Hernia J A M A, 99, 143, 1932
[7] Masson, J C, and Simon, H E Vaginal Hernia Surg, Gynec, and Obstet, 47, 36, 1928
[8] Miles, L M Pelvic Hernia Surg, Gynec, and Obstet, 42, 482, 1926
[9] Stearns, R J Vaginal Hernia of Douglas' Culdesac Am Jour Obst and Gynec, 31, 144, 1936
[10] Ward, G G Technic of Repair of Enterocele (Posterior Vaginal Hernia) and Rectocele as an Entity, and When Associated with Prolapse of the Uterus J A M A, 79, 709, 1922

DISCUSSION—DR WM F SHALLENBERGER (Atlanta, Ga)—Failure to recognize the fact that you are dealing with a posterior vaginal or perineal hernia is one of the reasons for failure to get permanent results from a perineal repair One of the first cases of this kind with which I met in private practice was referred to me by a general surgeon some 25 years ago He had repaired the perineum on two different occasions, but there had been prompt recurrence, following each operation, of what he thought was a large rectocele Careful examination showed that she really had a posterior vaginal hernia or enterocele In this instance a ventral fixation of the uterus was first accomplished, attaching the posterior surface of the uterus to the anterior abdominal wall The cul-de-sac, which had been dissected down between the rectum and vagina to the perineal floor, was then obliterated by introducing a

series of purse-string sutures of Pagenstecher linen These procedures were then followed by a third perineal repair The results were satisfactory Obliteration of the cul-de-sac from above is one of the methods of handling these cases

Repair from below can also be carried out satisfactorily where the condition is recognized and obliteration of the sac can be effected If the condition is overlooked failure to get permanent results from perineal repair is almost certain to occur I believe this condition of dissecting cul-de-sac with posterior vaginal hernia is much more common than is generally recognized

DR EDWARD H RICHARDSON (Baltimore, Md) —I think Doctor Black has rendered an important service in calling specific attention to these vaginal herniae, because they are very often overlooked It must be borne in mind that posterior vaginal hernia as an entity, isolated as the only local pathology, is indeed a rare thing As Doctor Black has stated, in both instances there was an accompanying prolapse of the uterus Therefore, it is difficult to discuss this particular type of hernia without consideration of the entire subject of vaginal hernia I would, however, like to emphasize one or two points, which have caused me to change my earlier views with regard to the best management of vaginal hernia I do not mean the small type consisting of a simple rectocele or cystocele I am speaking now of the advanced grade ones in association with marked prolapse of the uterus Many men are wedded to the idea that in such cases total vaginal hysterectomy is the best form of treatment I need not comment on the fact, which you will readily admit, that women presenting this type are usually elderly women, and any type of celiotomy is a far more serious procedure than a vaginal operation for the correction of this condition Therefore, my practice is to avoid celiotomies if possible Vaginal hysterectomy has been performed with striking success for many years, and several excellent operations have been devised from which one can choose Until a few years ago my own belief, based upon a lifetime of experience, was that vaginal hysterectomy is the most satisfactory method of treating uterine prolapse, because in private practice it gave uniformly good results and I believed the same was true also of the clinic cases However, in checking over our clinic cases we found that 30 per cent were partial failures After they had resumed their occupation of hard labor, in many instances, we found recurrences, either in the form of a small cystocele or rectocele—the incidence of such recurrence judged by rigid anatomic standards was 30 per cent, whereas the incidence after the interposition operation was only 4 per cent, judged on an anatomic basis That led me to revise my operative plan I have recently published a composite operation, every step of which has been borrowed from a well established plan of dealing with these vaginal herniae, and incorporated them into a single procedure, which has proven eminently successful

DR DONNELL B COBB (Goldsboro, N C) —Having two cases of perineal hernia in the hospital at the present time, I have been particularly interested in Doctor Black's paper These are the first such cases I have recognized

One is a patient, age 60, who had had an operation for uterine prolapse and rectocele performed elsewhere, at which time a ventral fixation of the uterus and repair of the perineum was accomplished She stated that she considered herself worse than before the operation A posterior vaginal hernia was recognized at the time of the second operation The hernial sac projected between the rectum and the posterior vaginal wall and extended downward as far as the introitus After performing a vaginal hysterectomy, the hernial sac was dissected free, closed with a purse-string suture and attached to the

approximated broad ligaments, thus almost completely obliterating the cul-de-sac A repair of the perineum completed the operation

The second case gave a history that at age 14, a uterine prolapse developed, the result of drawing and carrying heavy buckets of water No effort had been made to correct this condition until she presented herself for treatment at the age of 55 At operation the prolapsed uterus was removed vaginally and on dissecting the perineum a hernial sac was found extending downward between the rectum and the posterior vaginal wall The sac was dissected out, closed, and sutured to the approximated broad ligaments, after which the perineum was repaired

Doctor Black has called to our attention a condition which may easily be overlooked In operating for the repair of rectocele the failure to recognize and eradicate a perineal hernial sac would most certainly predispose to a recurrence of the condition Such would account for poor results which occasionally follow perineorrhaphy

DR WM T BLACK (closing) —The case previously reported and the two reported today were operated upon vaginally If it is necessary to open the abdomen, the sac may first be dissected free through the vagina and the stump sutured to the uterus from above Since completing this paper I have had another case of posterior vaginal hernia in a nulliparous woman The hernia protruded through the vaginal orifice Due to a small fibroid it was necessary to perform a celiotomy, at which time a supravaginal hysterectomy was performed The peritoneum was drawn upward and plicated, then sutured to the cervix

VAGINAL CYSTS

WITH SPECIAL REFERENCE TO THOSE OF GARTNER'S DUCT

ROBERT L SANDERS, M D

MEMPHIS, TENN

WE ARE indebted chiefly to the German authors of the nineteenth century for our first accurate descriptions of the etiology and histology of vaginal cysts So thorough were their studies, in fact, that apparently little of fundamental importance remained to be discovered, contributions during recent decades have consisted, in the main, of reports of cases A number of resumes, however, have been presented, several of them describing in detail different phases of the subject Cullen,[3] in 1904, gave a comprehensive picture of vaginal cysts and collected the cases reported up until that time His article on the subject still remains outstanding in American literature

Vaginal cysts have been classified according to their origin into three principal types The first of these, which constitute the majority, are inclusion cysts They are caused by enclosure of epithelial cells in the vaginal stroma during the healing of birth injuries or repair of perineal lacerations The author has seen many cysts of this variety The average size is that of a cherry, and the contents a thick, sebaceous, yellow substance Their walls are fibrous and generally lined by several layers of squamous epithelium They are seldom definitely encapsulated Multilocular forms are not uncommon

Another, though rare, type of vaginal cyst is formed by the occlusion of the glands following inflammation of the vaginal mucosa The lining epithelium may be columnar, resembling the cells of the cervical glands, or it may be cuboidal or flat Glandular cysts are small, and the surrounding membrane usually is inflammatory

Early investigations in embryology of the urogenital tract revealed that anomalies of development are responsible for a large number of tumors of this region Thus, it has long been recognized that faulty embryologic growth may cause the persistence after birth of remnants of the wolffian ducts, and these may continue to secrete, enlarge, and form cysts even in adult life Many retroperitoneal growths, tumors of the broad ligament, the parovarium, uterus and cervix are attributed to wolffian body origin In a few cases, the ducts have been found present practically in their entirety, from the superior pole of the kidney to their openings near the hymen Greig and Herzfeld[9] reported two tumors of wolffian duct origin in young children, one of which was 145 Mm and the other 150 Mm in length In both cases they obtained roentgenograms of the ducts after their injection with bismuth Watts[19] described a cyst of the paravaginal portion of the duct, in a woman, age 41, which could be probed for several inches upward from its orifice

The lower, paravaginal segment of the wolffian body, which is known as Gartner's duct, is one of the more common sites of vaginal cysts This is not surprising in the light of Kock's[12] finding that it is patent for a distance of five to 20 cm in 80 per cent of women Dilatation takes place when the duct is completely occluded or has only a small opening, in the latter event, a vaginal discharge may be present Cysts of this segment of the duct are located, as a rule, on the anterior or lateral vaginal wall, the opening being normally in the immediate vicinity of the hymen A few, however, have been reported posteriorly The cysts may grow to be quite large, especially during pregnancy, causing much discomfort and interfering with childbirth It is probable that the rich blood supply incident to the pregnant state stimulates their growth Several authors have described cases in which it was necessary to excise or drain a cyst of Gartner's duct before delivery could be effected Frank[6] performed a cesarean section because of this complication As a rule, the masses are sessile and oblong, although they may be pedunculated, and slightly irregular in shape The majority are single, yet they may be multiple, arising from consecutive remnants of the duct In Frank's case there were four large cysts along one side of the vagina From the histologic appearance, he regarded these as of Gartner's duct origin

Histologically, cysts of Gartner's duct vary widely The walls are fibrous and usually thin, but the lining may consist of several types of epithelium, from the stratified squamous to high columnar and papillary formations, including cuboidal, cylindrical, ciliated and nonciliated epithelium The cells may be arranged in one or many layers On the other hand, the larger cysts may be devoid of epithelium altogether, because of intracystic pressure The variety of epithelium found in the duct accounts for this diversity in the cyst It also points to a continuing differentiation of the cells—an explanation which has been offered for the infrequent malignant degeneration of these cysts The contents consist of a mucinous fluid, either colorless or of an amber shade Upon hemorrhagic infusion, the fluid is converted into a chocolate colored, gelatinous substance

Departures from these forms may be observed in more solid tumors, such as one found by Spencer[17] in a woman of middle age This was a pedunculated, benign adenoma, the size of a duck's egg, which sprang from the vaginal fornix The tumor consisted of glands lined with a single layer of columnar epithelium, in parts thrown into papillations, and set in a fibromuscular stroma

Of less significance because of their exceedingly rare incidence are vaginal cysts caused by improper development of the mullerian ducts in the embryo Freund[7] was the first to discover that maldevelopment of these ducts may lead to the formation of a double uterus, one with a blind vagina, with which it may or may not communicate Such a vagina, if in connection with its supernumerary uterus, may become distended with menstrual fluid, or, if separate, may be filled with secretion In either case, it forms a tumor

in the lateral wall of the normal vagina Only a few instances of this condition are reported in the literature

It should be mentioned that gas cysts and echinococcus cysts are also observed occasionally in the vagina The former are believed to be caused by the *Bacillus aerogenes capsulatus* They develop during pregnancy, are small, and readily collapse on puncture, or disappear spontaneously after delivery The diagnosis of echinococcus cysts may be made by microscopic study

Differentiation between these various types of cysts will depend principally upon the size, location, and microscopic picture Inclusion cysts may be suspected from their location, in or near a perineal scar Cysts of Gartner's duct may be conspicuous for their size, and perhaps because of a discharge In the presence of a vaginal discharge of obscure origin, therefore, one should make a careful search for such a cyst Aside from these features, one must rely upon the pathologist's report

Dilatations and anomalous ureters connected with ectopic kidneys may be confused with true vaginal cysts The presence of a ureter, however, may be proved by an incontinence of urine or an escape of urine on puncture of the mass There has also been much discussion as to the possible origin of vaginal cysts in the urethral glands or Skene's ducts, but this still remains a debated question It is believed that Gartner's duct may open into the urethral meatus

Vaginal tumors are often mistaken for colpoceles Downing[4] described a rather singular tumor which was so diagnosed On abdominal section, it proved to be a pedicled fibromyoma 15 cm long, 8 cm wide, and 2 cm thick, protruding beneath the base of the bladder and extending up behind the pubic ramus into the soft tissues

Faber[5] encountered another interesting growth in the vaginal wall This was a fibromyxolipomatous tumor of the right broad ligament, weighing 500 Gms , which extended down the right wall of the vagina and bulged into the perineum

A posterior vaginal hernia may also closely resemble a vaginal cyst The diagnosis of a hernia generally can be made by digital examination Moreover, the mass, although large, will be found in the floor of the vagina

The author wishes to present a case of a cyst of Gartner's duct which has recently come under his observation It is interesting chiefly because of its size, which was so large as to protrude from the vagina, cause much discomfort, interfere with normal functions, and consistute a potential obstruction to labor

Case Report—P S L , white, female, married, age 38, was first seen February 18, 1937 She had had one child, age 12, but no other pregnancies , her menstrual cycle had been normal Her past history was essentially negative except as related to her present complaint She sought examination on account of a large tumor which was bulging from the vagina

Several months prior to her pregnancy, 13 years ago, she discovered a small lump,

the size and shape of an olive, in the anterior vaginal wall just below the urethra It grew to the size of a hen's egg during gestation, but did not obstruct delivery After the birth of her child it had enlarged no further until three years ago, when it had again begun to grow, increasing rapidly for a year Since that time it had remained stationary Three weeks before examination she had injured it in some manner and an ulcer had formed on the vaginal surface, accompanied by a slight bloody secretion and some irritation

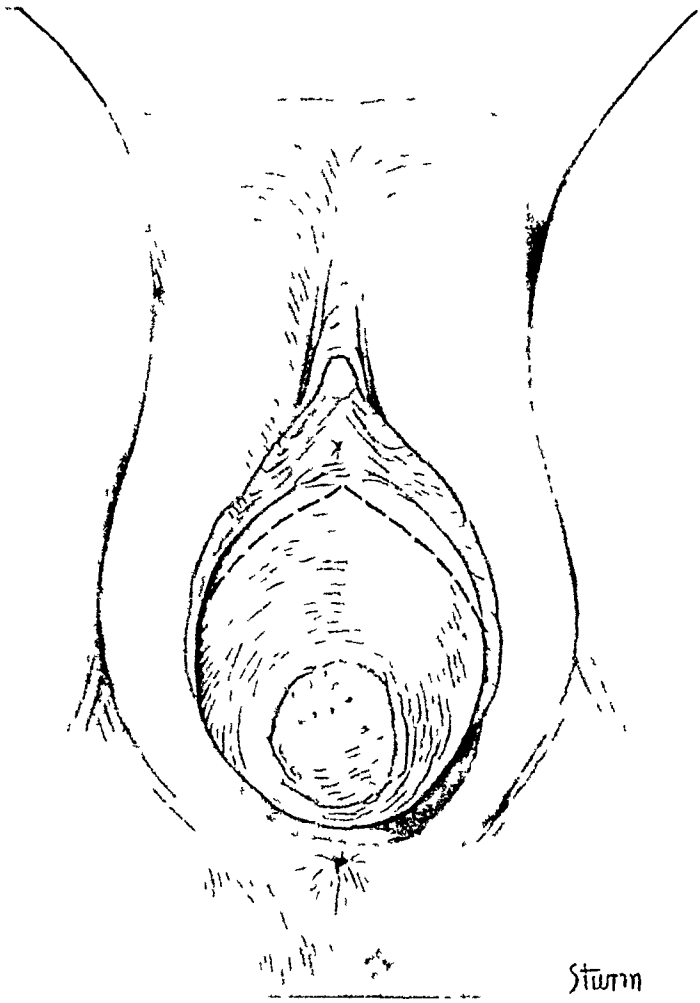


FIG 1—Showing a large vaginal cyst protruding through the labia deforming and obstructing the introitus sufficiently to interfere with child birth It extends from the urethra to the cervix in the midline of the anterior wall involving the vaginal tissue equally on both sides The large ulcer on the surface bled easily on manipulation The dotted line represents the proposed line of incision

and tenderness On lying down she could partially reduce the mass, but when she stood or walked, it protruded far out of the vagina, causing discomfort by contact with her clothing It did not interfere with urination and bowel movements

Physical Examination revealed a well developed, moderately obese woman Respiratory and cardiac systems, normal, blood pressure, 120/70, and blood and urine studies gave negative results In her left flank was a lipoma the size of a goose egg The abdomen was normal in size and contour, and no tenderness nor mass could be elicited by palpation

Pelvic Examination—The perineum was moderately lacerated, its support fairly good There was a large tumor protruding through the labia and extending several inches

FIG 2.—Showing the cyst being extirpated through the muscularis down to the mucosa Note the invasion of the bladder wall through the muscularis down to the mucosa All the incised structures were thickened secondary to a low grade inflammatory reaction and the bladder mucosa was thick and edematous

FIG 3.—Showing the thickened bladder and vaginal walls being closed with interrupted sutures of chromic catgut The redundant vaginal mucosa was excised with the cyst and the tissue approximated evenly and smoothly The bladder mucosa was not damaged No drain used

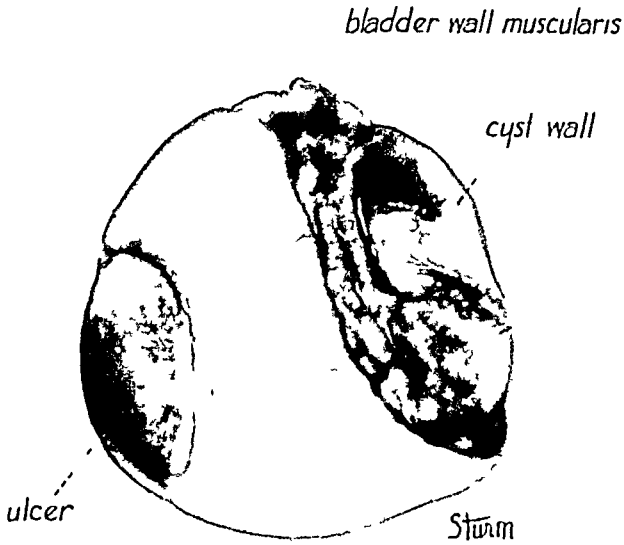


FIG 4.—Showing the gross specimen after its removal. Note the large mucosal ulcer, the thick muscular layer from the bladder wall, and the portion of the cyst wall which was in contact with the bladder mucosa. The cyst measured 9 by 8 by 4 cms. It contained 80 cc. of turbid mucilaginous brown fluid.

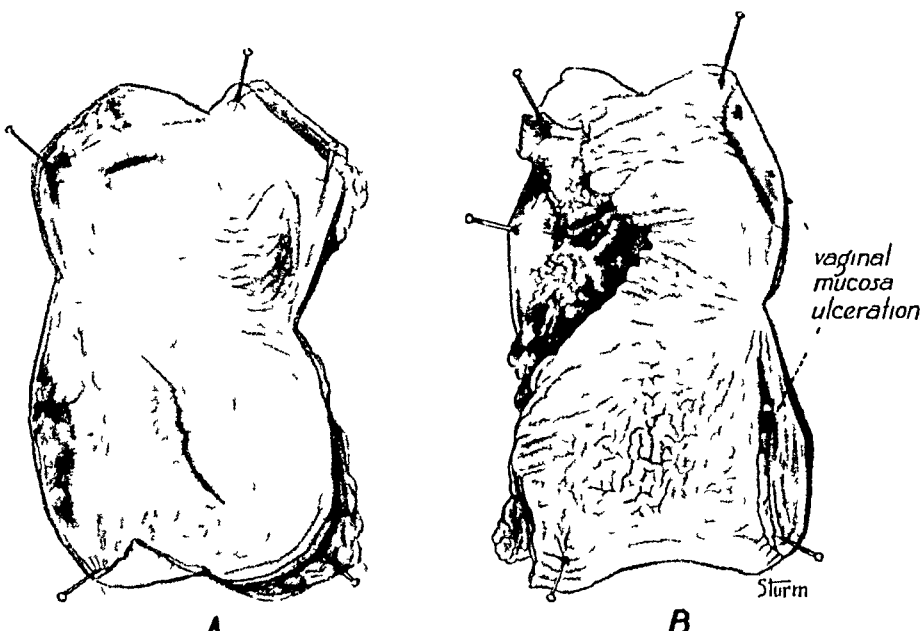


FIG 5.—(A) Showing the cyst open. The lining is smooth, it is slightly irregular in areas, but is without constrictions or lobulations. (B) Showing the exterior surface of the cyst. The vaginal mucosa is thrown into folds and is thick and edematous. On the left margin may be seen muscularis from the bladder wall, and on the right the large mucosal ulcer observed on the front of the intact cyst.

outside the vagina, on its most dependent portion was an ulcer one and one-half inches in diameter (Fig 1) Its general appearance was that of a procidentia, and at first the ulcerated area gave one the impression of an eroded cervix The mass was semifluctuating, slightly tender on the surface, and could be pushed back partially within the vagina Behind it, the cervix could be felt in its normal position It was then apparent that the protrusion was caused by a large cyst located in the midline of the vagina, growing laterally for an equal distance on both sides and longitudinally from just below the urethral meatus to the anterior face of the cervix The posterior and lateral fornices were not

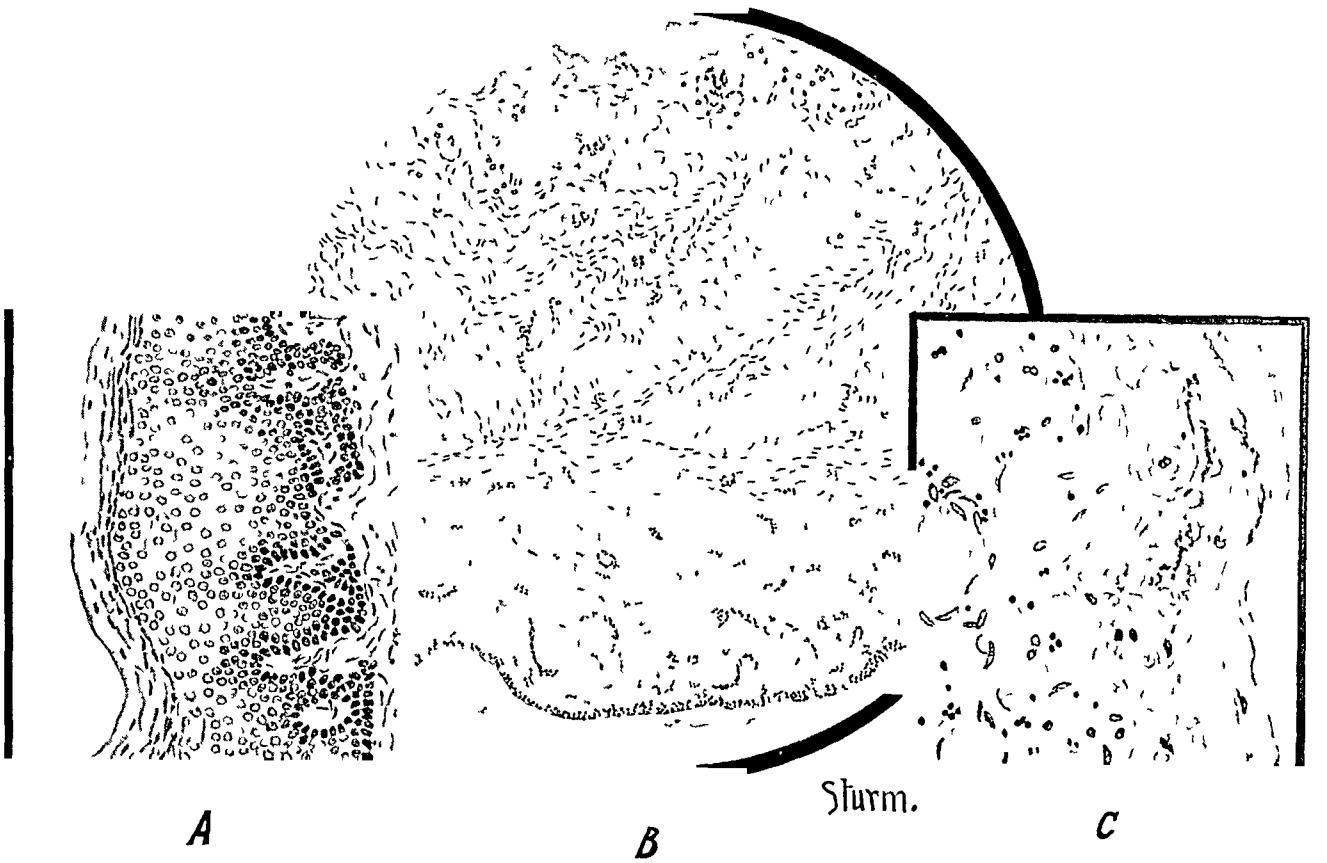


FIG 6—(A) Showing section of the vaginal mucosa which consists of stratified squamous epithelium, with rather marked cornification of the superficial layers The papillae are normal in appearance (B) Showing the entire thickness of the cyst wall where excised from the vagina The lining is composed of low cuboidal epithelium the greater part of which consists of dense connective tissue and interlacing bundles of smooth muscle fibers (C) The ulcerated area at the most dependent portion of the cyst is characterized by necrosis and leukocytic infiltration

involved No other cysts were found in the vagina The fundus of the uterus was normal in size and position, and no masses could be felt in the adnexa Nothing abnormal was discovered on rectal examination

Diagnosis—The mass was diagnosed as a vaginal cyst, probably arising from Gartner's duct

Operation—Under cyclopropane anesthesia, an elliptical incision was made, beginning just below the meatus, was carried laterally, well beyond the ulcer and posteriorly to the cervix The vaginal wall was dissected free for an inch and a half on each side until the muscular layer of the bladder wall was reached, when it was found that the tumor extended still deeper into the structures of that viscus The muscular layer was then divided down to the bladder mucosa, which was in contact with the cyst A line of cleavage was established and the cyst removed with a portion of the muscle composing the bladder wall, leaving the bladder mucosa exposed for a distance of two inches The bladder mucosa was thick and edematous, but was not damaged (Fig 2) The cyst

was removed intact, the bladder muscularis sutured, the vaginal incision closed with interrupted chromic catgut sutures (Fig 3), without drainage

Postoperative Course—The patient was catheterized every eight hours for the first three days, then allowed to void naturally The wound healed by primary union, and she was dismissed from the hospital two weeks after operation When next examined, on April 7, 1937, nearly two months after operation, the vaginal wall had healed entirely, the suture line was in perfect condition, and all the structures were normal She has had no further pelvic trouble

Pathologic Examination—Gross "The specimen consists of a soft, fluctuating mass, measuring 9 by 8 by 4 cm, covered by mucous membrane, and presenting on its most dependent portion an ulcerated area 4 cm in diameter The cyst wall is approximately 4 Mm in thickness The area of excision from the bladder wall is 6 cm in diameter The lining of the cyst is soft and smooth (Fig 4), its contents 80 cc of turbid, mucilaginous brown fluid

"*Microscopic* Section of the vaginal mucosa shows a stratified squamous epithelium, with rather marked cornification of the superficial layers (Fig 6A) The greater part of the lining of the cyst is composed of low cuboidal epithelium, chiefly in a single layer of cells, the remainder consists of dense connective tissue and interlacing bundles of smooth muscle fibers (Fig 6B) There is necrosis and leukocytic infiltration of the ulcerated area (Fig 6C) *Pathologic Diagnosis* Large vaginal cyst of embryonic origin, probably of Gartner's duct"

COMMENT—It is difficult to correctly classify vaginal cysts There seems to be no criteria by which one can identify the histologic structures and thereby definitely settle the problem After reviewing many articles on the subject, studying numerous case reports and microscopic pictures as described by various writers, and after a thorough study of the case reported here, it is the author's belief that this large cyst belongs to that group originating in Gartner's duct

An interesting feature of cysts of Gartner's duct is that they seldom become malignant Several authors have called attention to the fact that the cells continue to differentiate rather than to remain in their embryonic state, thus almost eliminating the cancer potentiality

Considering the importance of vaginal cysts, in that they may interfere with normal functions and become troublesome and even cause serious complications at childbirth, it seems that the subject has not been discussed as freely as it merits Many vaginal cysts which have been discovered are, doubtless, never reported It is hoped that this paper will stimulate an increased interest in all varieties of vaginal tumors, that we may have, if possible, a better knowledge of the histologic characteristics of each type, as well as a more accurate record of their incidence, and, finally, that we may more fully appreciate the necessity for removing them while small in order to prevent the possibility of their growing to obstructive proportions

REFERENCES

[1] Berry-Hart, D A Contribution to the Morphology of the Human Urogenital Tract Jour Anat and Physiol, 35, 330, 1901

[2] Bland-Sutton, J On the Origin of Certain Cysts—Ovarian, Vaginal, Sacral, Lingual, and Tracheal Jour Anat and Physiol, 20, 432, 1886

[3] Cullen, T S Vaginal Cysts Trans Amer Gynec Soc, 29, 459, 1904

[4] Downing, W Anterior Colpocele Due to Fibromyoma J A M A, 98, 1157, 1932
[5] Faber, J E Perineal Hernia Proc Staff Meet Mayo Clin, 10, 653, 1935
[6] Frank, R T Caesarean Section Necessitated by a Large Gartner's Cyst Am Jour Obstet, 72, 467, 1915
[7] Freund, W A Beitrage zur Pathologie des doppelten Genitalkanals Ztschr f Geburtsh u Gynak, 1, 231, 1877
[8] Gebhard, C Cysten der Vagina Pathologische Anatomie der Weiblichen Sexualorgane S Hirzel, Leipzig, 1899
[9] Greig, D M, and Herzfeld, Gertrude On the Persistence of Complete Wolffian Ducts in Females Edinburgh Med Jour, 34, 701, 1927
[10] Herbst, R H, and Polkey, H J Ectopic Ureteral Openings Jour Urol, 17, 61, 1927
[11] Ingraham, C B Vaginal Cysts J A M A, 77, 1487, 1921
[12] Kocks, J Ueber die Gartner'schen Gange beim Weibe Arch f Gynakol, 20, 487, 1882
[13] Meyer, R L Zur Kenntnis des Gartner'schen (oder Wolffschen) Ganges besonders in der Vagina und dem Hymen des Menschen Arch f microskopische Anat, 73, 751, 1908–1909
[14] Miles, L M Vaginal Cysts Surg, Gynec, and Obst, 40, 381, 1925
[15] Secheyron, L Des Abouchements anormaux de l'Uretere dans le Vagin et a la Vulve Arch de Tocologie, 16, 354, 1889
[16] Silhol, J, and Bourde, Y Les Kystes Wolffiens Arch franco-belges de Chir, 27, 377, 1924
[17] Spencer, H R Adenoma of the Vaginal Fornix Simulating Cancer of the Cervix Jour Obstet and Gynæc Brit Emp, 30, 44, 1923
[18] Strong, L W Vaginal Cysts Am Jour Obstet and Gynec, 1, 357, 1920–1921
[19] Watts, R Quoted by Greig and Herzfeld
[20] Wood-Jones, F The Nature of the Malformations of the Rectum and Urogenital Passages Brit Med Jour, 2, 1630, 1904

DISCUSSION.—DR LUCIUS E BURCH (*Nashville, Tenn.*).—Cysts of the vaginal wall are unusual, those, however, of the inclusion type are not of great import. I have seen a rather interesting inclusion cyst following gonorrhea in infancy, and also a case of marked vaginal contraction, likewise following gonorrhea in childhood. The cysts of Gartner's are found anterior and occasionally lateral to the vagina. I have never seen a solid tumor of the vagina. Such tumors must be exceedingly rare. A more common cyst of the vagina of some importance is the emphysematous cyst. These appear during pregnancy, are relieved by puncture and usually disappear after pregnancy.

MEMOIRS

WILLIAM HALL GOODWIN

1882–1937

WILLIAM HALL GOODWIN died suddenly at his home, University, Va., on May 23, 1937. He had suffered for some time with coronary disease. He was born at Lexington, Ky., February 3, 1882, son of the late William Moore and Katherine (Hall) Goodwin, and spent his early years in Lexington, Ky. In 1904, he was graduated with the A.B. degree from Transylvania University, and obtained his medical degree from the University of Virginia in 1908. The



WILLIAM HALL GOODWIN, M.D.

following year he remained as an intern in the University of Virginia Hospital, and then spent one year on the Surgical Service of Bellevue Hospital in New York City. On returning from New York he became resident surgeon at the University of Virginia Hospital and, in 1910, was made adjunct professor of surgery and gynecology in the University of Virginia. Subsequently he was promoted to the professorship of clinical surgery and gynecology, which position he filled until about a year before his death, when he retired on account of ill health.

In 1917, Doctor Goodwin organized the University of Virginia Base Hospital Unit, designated as Base Hospital No. 41. He was commissioned Major,

the unit was mobilized at Camp Sevier and went overseas from New York City, in July, 1918 Shortly before sailing Doctor Goodwin was promoted to Lieutenant-Colonel and his technical duties were those of Chief of the Surgical Service of Base Hospital No 41, which was stationed at St Denis, France On April 19, 1919, he received a citation from Gen John J Pershing and, following his honorable discharge four days later, returned to the United States and resumed his duties with the medical faculty of the University of Virginia

Doctor Goodwin was a member of the Virginia State, Southern and American Medical Associations, and a fellow of the American College of Surgeons and the Southern Surgical Association His fraternities were Kappa Alpha, Phi Rho Sigma, Sigma Xi, Alpha Omega Alpha and Phi Beta Kappa He was a Presbyterian

On December 27, 1921, he married Miss Mary Stuart Cocke, of Roanoke, Va , who survives him

Doctor Goodwin was a good teacher and able surgeon He was greatly respected and beloved by his students and patients His surgical skill and good judgment contributed much to the upbuilding of the surgical department of the University of Virginia His genial disposition and innate kindness won for him a host of friends

STEPHEN H WATTS

JAMES KNOX SIMPSON

1886–1937

JAMES KNOX SIMPSON, Fellow of the Southern Surgical Association, died at his home in Jacksonville, Florida, on May 18, 1937 He was born in



JAMES KNOX SIMPSON M D

Laurens County, South Carolina, in 1886, and obtained his preliminary education at Clemson College, South Carolina, being graduated from the University of Pennsylvania Medical School in 1909 The next two years he spent at

the Mayo Clinic in Rochester, Minnesota, and, in 1912, located in Jacksonville, Florida, where he resided until his death

Doctor Simpson's surgical skill rapidly won for him a prominent place in the ranks of his profession He took an active interest both in organized medicine and in hospital work He was a member of his County, State, and National organizations and served as President of his County Society, as well as being a member of many important committees He was on the staff of St Luke's Hospital, the Duval County Hospital, and St Vincent's Hospital of Jacksonville, Florida In addition to being a Fellow of the Southern Surgical Association, he was also a Fellow of the Southeastern Surgical Congress, the American College of Surgeons, and the Southern Medical Association During the World War he was on the surgical staff of the United States Naval Hospital at Charleston, South Carolina

Doctor Simpson took an active interest in civil and religious affairs He was an Elder in the Riverside Presbyterian Church, Jacksonville, and took great interest in the affairs of this church

He possessed many talents and, as an especial hobby, was an amateur sculptor One of his works was a bronze plaque of the late Dr Joseph E Venable, Founder and Pastor of the Riverside Presbyterian Church in Jacksonville, which he presented to the Church

Doctor Simpson's widow and three children survive him He will be greatly missed, not only in professional, but in civic circles

GERRY R HOLDEN

JAMES ERNEST STOKES

1868–1937

Born in Baltimore, Md, the son of an Episcopal clergyman, Dr James Ernest Stokes received his medical degree at the University of Maryland



James Ernest Stokes M D

He was an intelligent and serious student, ambitious enough to spend the following two years in Europe, studying chiefly in the University of Freiburg,

Germany Returning to Baltimore, he was appointed Resident Gynecologist in the Johns Hopkins Hospital and retained this position for a period of six years under his Chief, Dr Howard A Kelly Through this excellent training and indomitable interest in his work Doctor Stokes was eminently prepared for the career which he so ably fulfilled

In 1899, he was invited by Dr John Whitehead, of Salisbury, N C, to join him in the establishment of a private hospital, which was known as the Whitehead-Stokes Sanatorium This institution continued intact for 22 years, conducted for a time by Doctor Stokes alone after the death of Doctor Whitehead In 1921, it became the Salisbury Hospital and later (1932) the Rowan General Hospital affiliated with the Duke Endowment This new modern plant of 80 beds, fully equipped, a real community hospital, is the direct successor of the original institution begun nearly 40 years ago From first to last, throughout its existence, Doctor Stokes was the prime mover in all the efforts to enlarge the institution, to improve its facilities and to keep it abreast of the times He joined heartily in the plan to merge his private interests with the larger hospital and generously gave of his time and means for the public good A year before his death he was elected chief of the staff of the combined institution For two or three years previously he had not been in active practice on account of ill health, but his advice was continually sought in consultation

The professional affiliations of Doctor Stokes included membership in his state and local organizations, in the American College of Surgeons, and a tour of duty at an officers' training camp during the World War He was chosen a Fellow of the Southern Surgical Association in 1904 and served as Vice-president in 1917 He was faithful to his duties as a churchman and as a citizen Surviving him are his widow, the former Miss Rebekah Marsh, of Salisbury, a daughter, and a sister, Miss Emma L Stokes, of Baltimore

This enumeration of positions held, honors bestowed and work performed, does not begin to express adequately the deeper things in the life of Doctor Stokes Coming into a strange community, after a long hospital sojourn, he fell at once into the ways of the people, and won for himself, both personally and professionally, a place of lasting regard As a man he was modest to a fault, shy to the public gaze and unobtrusive in assemblies, but to his good friends and reciprocal colleagues he was warmly affectionate and understandingly intimate He admired those whom he found worthy of confidence He had no taste for sham and pretense

Doctor Stokes was first and foremost a gynecologist of singular ability and his practice throughout was largely confined to that specialty Yet by association and experience he extended his surgical training to broader fields His capacity was unquestioned, for he combined judgment, vision and technic in balanced proportion His reputation reached far from his immediate neighborhood, and in his prime he "drew" distant patients, chiefly those in quest of his established gynecologic skill At the beginning of his work in Salisbury he found such untrained assistants and inadequate equipment that

he virtually performed the offices of nurse, orderly and anesthetist as well as operator—so desirous was he of giving his patients the best attention That was Stokes all through, conscientious to the *n*th degree He never spared himself, too frequently and too freely giving of his time, labor and thought to the remotest detail

The published papers of Dr Stokes were few in number and far apart in time But they were prepared with infinite patience and were usually comprehensive His regular attendance upon the sessions of the Southern Surgical Association was the one feature of the year for him and he was ever a thoughtful listener and a wise counsellor in the inner circles of personal companionship His last appearance at the meeting of 1934 was marked by the same whole-hearted devotion to his friends and the spirit of our organization

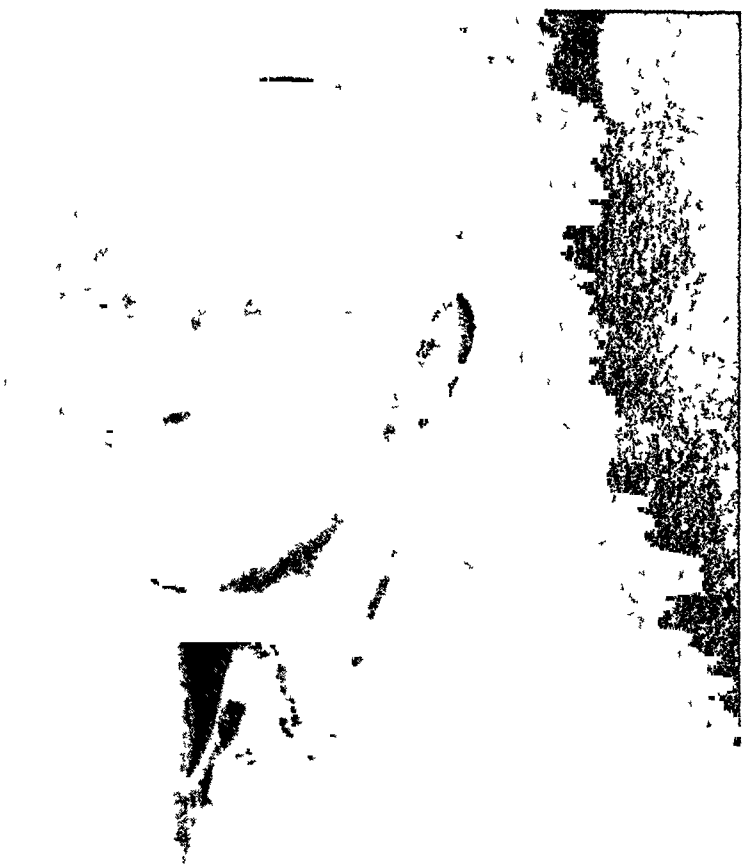
Ernest Stokes was truly a *gentle*-man Those who knew him best will miss him most

HUBERT A ROYSTER

NATHAN WINSLOW

1878–1937

DR NATHAN WINSLOW, Professor of Clinical Surgery in the University of Maryland and member of the Southern Surgical Society, died October 7, 1937, of a fracture of the skull resulting from an automobile accident He



NATHAN WINSLOW, M D

was the oldest son of the late Dr Randolph Winslow, Professor of Surgery in the University of Maryland from 1902 to 1920, himself a member of the Southern Surgical Association and its president in 1921

Dr Nathan Winslow received his bachelor's degree from the Johns Hopkins University and his doctor's degree in medicine from the University of Maryland in 1901, being the honor man in his class St John's College at Annapolis, Maryland, gave him a master's degree in 1913 He was house officer in the University Hospital for three years after graduation Soon

after leaving the hospital he married Margaret Kable Massey, who had recently graduated from the Training School of the University Hospital

He lived out his professional life as he started it—in intimate association with the different phases of a medical school and a teaching hospital, with only one break He was a member of the Medical Reserve Corps, and, in 1916, was called into active service, going with General Pershing into Mexico Soon after the entrance of the United States in the World War, he was transferred to Fort Oglethorpe and was later sent to Newport News, Virginia, where he served until 1920 in the Embarkation Hospital with the rank of major

He advanced through the various grades of the surgical department of his alma mater until he was made Professor of Clinical Surgery in 1931 He served his school with distinction in a number of fields, but he was best known because of his long career as Editor of the Bulletin of the School of Medicine His editorship of various University of Maryland publications occupied much of his time for 27 years During this long period he wrote numerous editorials, reviews and items of medical news and devoted many long and weary hours to the editing and correction of students' essays, because he was a firm believer in the value of the once popular thesis as a part of the student's duty and training He was a writer of excellent English and published a long list of articles on many clinical subjects Among these are a number of papers exhibiting exhaustive literary research, especially in the fields of suppurative pericarditis and aneurysm At the time of his death he had been for several years in charge of the teaching of operative surgery in the animal laboratory and found time to carry on a number of research problems Indeed, his death was indirectly due to his devotion and faithfulness to any duty he assumed, as he was driving in the night on his return from North Carolina, where he had gone to visit a sick relative, hurrying back to Baltimore to meet his class the following morning

It is, therefore, very evident that his duties as editor, his writing, his teaching, his research, together with his practice, made of him a seriously busy man, but in addition to this he had an absorbing hobby—his interest in medical books and the library of the medical school

Of his character and personality much could be said He was essentially a modest man, but also a courageous one His outstanding qualities were his honesty, his sincerity and his kindness

ARTHUR M SHIPLEY

EDITORIAL ADDRESS

Original typed manuscripts and illustrations submitted to this Journal should be forwarded prepaid, at the author's risk, to the Chairman of the Editorial Board of the ANNALS OF SURGERY

Walter Estell Lee, M D

1833 Pine Street, Philadelphia, Pa

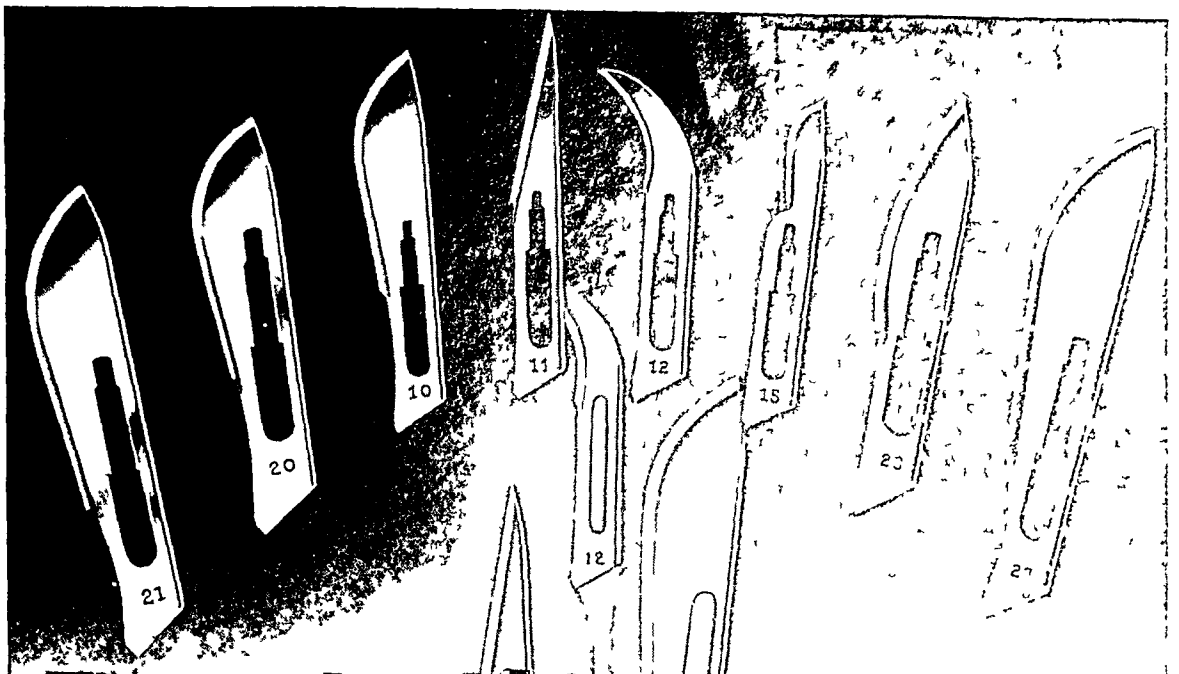
Contributions in a foreign language when accepted will be translated and published in English

Exchanges and Books for Review should be sent to James T Pilcher, M D , Managing Editor, 121 Gates Avenue, Brooklyn, N Y

Subscriptions, advertising and all business communications should be addressed

ANNALS OF SURGERY

227 South Sixth Street, Philadelphia Pa



There should be no compromise with QUALITY

Eight practical patterns of Rib-Back surgical blades form the dependable Bard-Parker line Each type of blade is designed to afford maximum cutting efficiency with undeviating accuracy and confidence-inspiring performance

Factory inspection of each individual blade, following every step of production, is the clinicians safeguard against blades which do not conform to our traditionally high standards of uniform sharpness, rigidity and strength

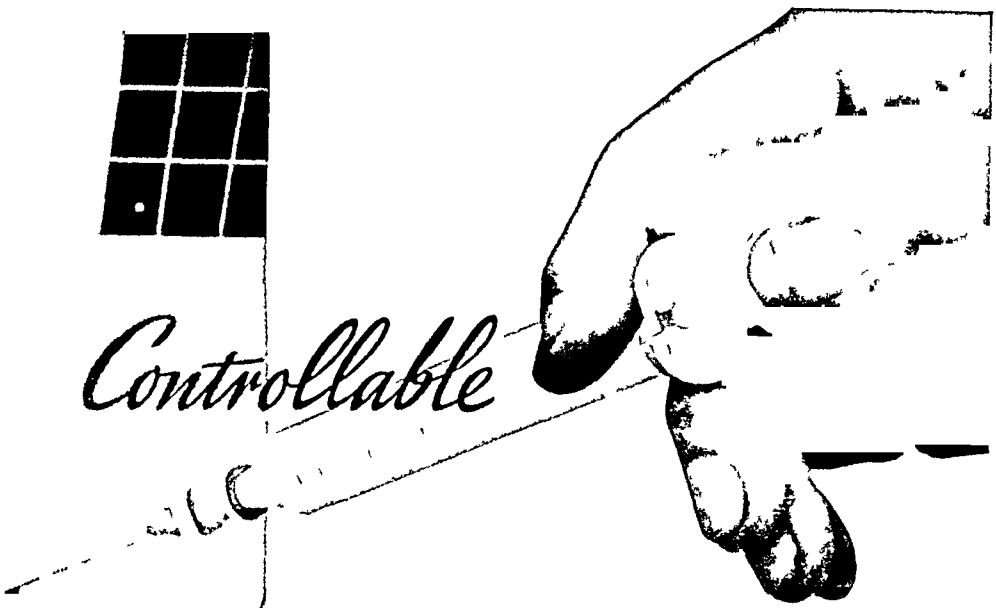
which permit longer blade utilization thus resulting in the reduction of blade consumption to a minimum Too, Rib-Back construction provides against attending interruptions and hazards due to glove cutting both factors of practical and economical importance

BARD-PARKER
Rib-Back Blades
possess superior characteristics

Ask Your Dealer

BARD-PARKER COMPANY, INC.
DANBURY, CONNECTICUT

A BARD-PARKER PRODUCT



Controllable

INTRAVENOUS ANESTHESIA

The voluminous and increasing literature demonstrates that Evipal Soluble produces surgical anesthesia quietly and without delay Disintegration of this synthetic in the body is so rapid that awakening takes place after fifteen or twenty minutes without nausea, vomiting or excitement

The newer refinement of administration technic—intermittent injection—makes it possible to maintain control of the effect of Evipal Soluble to a degree which has been compared with that of inhalation anesthetics



EVIPAL SOLUBLE

Evipal Reg U S Pat Off & Canada

Brand of CYCLURAL SODIUM

(Sodium salt of N methylcyclohexenylmethyl barbituric acid)

Evipal Soluble is supplied in ampules containing 0 5 Gm and 1 Gm of the sterile powder

Write for a copy of
Evipal Soluble Intravenous Anesthetic

WINTHROP CHEMICAL COMPANY, INC.

Pharmaceuticals of merit for the physician

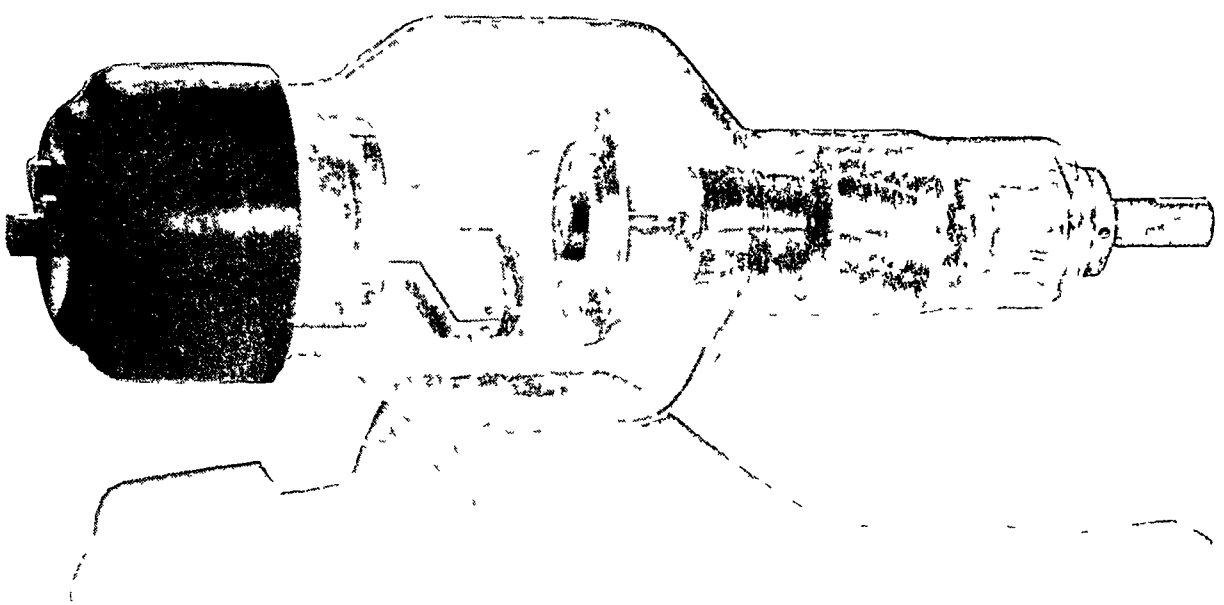
NEW YORK N Y WINDSOR ONT

Factories Rensselaer N. Y —Windsor, Ont

590M

Don't Ask Your X-Ray Operator to do the Impossible

. . . unless he is equipped with a G-E Model RT1-2 Rotating-Anode Coolidge Tube



An emergency patient is brought in—an accident case indicating a severe spinal injury X-ray films are wanted immediately—of excellent diagnostic quality, of course, to show the nature and extent of the injury

But because the patient cannot cooperate, and immobilization is not practical, the radiographer must anticipate motion and resort to a very short exposure time, which of course requires, in the conventional type of x-ray tube, a large focal area to carry the amount of x-ray energy needed The inevitable result a film in which detail sharpness has been sacrificed—due to the necessary use of a large focal spot And the individual who is supposed to interpret this film has to make the best of it

You can, however, overcome this serious handicap and provide an A-1 diagnostic service on every unusually difficult case by the installation of a G-E Model RT1-2 Rotating-Anode Coolidge tube With this tube unit, heavy x-ray energies *can* be applied safely to an *extremely small focal spot,* because the heat is distributed over the peripheral surface of a tungsten disc revolving at the rate of approximately 3000 r p m Moreover, in the RT1-2 are 2 focal spots (1 mm and 2 mm)—sizes which your x-ray operator usually employs with low x-ray energies for light work, to obtain the finest possible radiographic detail

In short, if you want to produce films which represent the last word in diagnostic quality, add an RT1-2 Coolidge tube to your present facilities Can you think of an investment more important?

Without obligation, ask for Pub No B25, which gives you all the pertinent facts

GENERAL ELECTRIC X-RAY CORPORATION

2012 JACKSON BLVD. CHICAGO, ILLINOIS

IMPORTANT NEW PUBLICATIONS

NEW WORK *JUST READY*

PEDIATRIC SURGERY

By EDWARD C BRENNER, A B , M D , F A C S

Associate Professor of Clinical Surgery, New York Post-Graduate Medical School, Columbia University etc

Octavo, 843 pages, illustrated with 293 engravings Cloth, $10 00, net

This work presents pediatric surgery as a special branch of general surgery While written for surgeons, it is of equal interest to practitioners in the emphasis that it places on diagnosis, the indications for operation, pre- and post-operative treatment, surgical therapy and the end-results The procedures which it recommends are confined to approved methods or those evolved from the writer's own experience in the New York Post-Graduate Medical School of Columbia University where it has long been recognized that the child's body is no place for heroic surgery and that special operative procedures are demanded These procedures are described in detail

This work shows the dangers peculiar to children—the loss of blood, exposure and rough handling of tissues and how they may be avoided Everything that the surgeon must bear in mind in pediatric operations is brought to his attention The book is a safe and conservative guide, advocating these procedures which when carefully planned and skillfully executed along the lines indicated, are well borne even by infants The book is splendidly illustrated and well organized, confining itself to practical demonstrations It is an important addition to pediatric literature, based on the fundamental fact that infants and children differ from adults in anatomy, in physiology and in their reactions

NEW WORK *JUST READY*

ATHLETIC INJURIES

Prevention, Diagnosis and Treatment

By AUGUSTUS THORNDIKE, Jr , M D

Surgeon in the Department of Hygiene, Harvard University, Assistant in Surgery Harvard Medical School, Associate Surgeon, Children s Hospital, Boston, Massachusetts

12mo, 208 pages, illustrated with 104 engravings Cloth, $3 00, net

This work reflects the author's experience as surgeon of the Department of Hygiene at Harvard University It presents the factors incident to the prevention of athletic injury, it describes the different types of injuries and their pathological nature and it is concluded with a concise description of the diagnosis and the treatment of practically every injury which may occur as a result of participation in sports This final section is, therefore, an invaluable source of reference to everyone responsible for the prevention and care of these conditions

The nature and frequency of injuries to various parts of the body are analyzed from the point of view of a surgeon of wide experience whose judgment and intuition has been developed throughout years of daily practice in a special art While few of such accidents are serious, they demand the accurate diagnosis and the effective treatment which this book supplies The work is thus an adequate minor surgery covering the diagnosis and treatment of all of the common injuries, whatever their origin

LEA & FEBIGER

WASHINGTON SQUARE
PHILADELPHIA, PA

Please send me books checked

☐ Brenner's Pediatric Surgery $10 00 ☐ Thorndike on Athletic Injuries $3 00

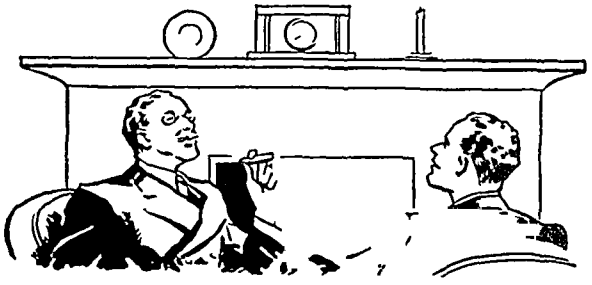
Name Address

(A of S 5-38)

Please mention ANNALS OF SURGERY when writing advertisers

An after hours talk about Balanced Radiography

BY DR. "X" AND DR. "Z"



DOCTOR X—"What is this I hear about Balanced Radiography?"

DOCTOR Z—"Oh yes, we were talking about that last night Balanced Radiography is a term that the Patterson Screen Company uses I think it is a good one, too, as applied to the advantages of Intensifying Screens"

DOCTOR X—"Well, it is a term that certainly intrigues my interest What does it mean?"

DOCTOR Z—"Simply this, that by using X-ray Intensifying Screens you bring into proper balance the various factors which the roentgenologist must deal with and control in the practice of his art"

X-RAY INTENSIFYING SCREENS ASSURE BALANCED RADIOGRAPHY

1 They greatly reduce exposure time
2 They greatly reduce danger of movement
3 They minimize danger of over-exposure to patients
4 They permit larger number of repeat exposures
5 They assure a high degree of detail and maximum contrast
6 They greatly reduce wear and tear on expensive X-ray tubes and equipment

Patterson X-ray Screens assure Balanced Radiography plus radiographs of highest possible quality

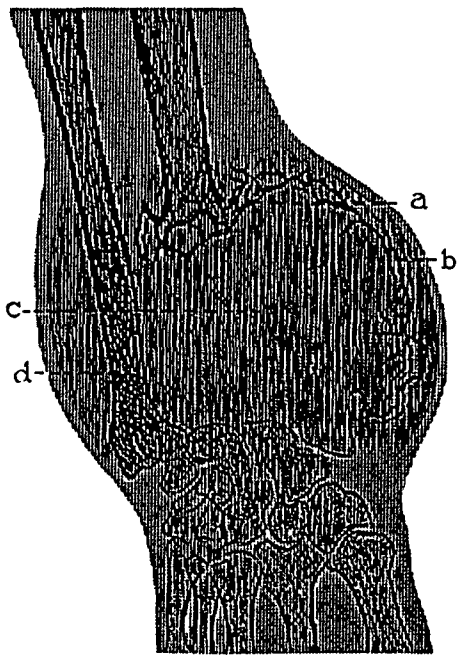
THE PATTERSON SCREEN CO, TOWANDA, PA

Patterson

INTENSIFYING **Screens** FLUOROSCOPIC

PATTERSON . THE WORLD'S STANDARD FOR HIGHEST SCREEN QUALITY

Just What Every Doctor Has Wanted



One of the unique drawings of the artist, Jean E Hirsch, who uses an entirely new method to illustrate diseases of the bones and joints

ON ROENTGEN DIAGNOSIS

TO speed up your ability to accurately diagnose conditions through the roentgen-ray method, Dr Leo G Rigler has completely covered this very extensive subject in an illustrated outline form that is admirably suited to everyday practice The indications, possibilities and limitations of the roentgen method of diagnosis are clearly stated The relative value of roentgen diagnosis in each disease process is definitely presented

Illustrations total 227 figures, but roentgenograms which serve to illustrate several conditions are frequently used, thus increasing their practical utility far beyond their actual number All are shown as negatives to save you the burden of reinterpretation The artist, Jean E Hirsch, has used a unique, new technique to illustrate the diseases of the bones and joints Her method permits accentuation of important points or composite figuring of several cases The entire book has been used in mimeograph form in lecturing to general practitioners as well as students, and has already emphatically proved its usefulness The book complete, with 227 illustrations and x-rays grouped in atlas fashion, is only $5 00 (Slightly higher in Canada) Ready May 15th

TABLE OF CONTENTS:

The book has been divided into eleven sections, as follows

I General Principles of Roentgen Diagnosis
II Bones and Joints
III Diseases of Spine and Spinal Cord
IV Skull and Its Contents
V Thorax
VI Digestive Tract
VII Gall Bladder
VIII Abdomen
IX Urinary Tract
X Female Generative
XI Miscellaneous

OUTLINE OF ROENTGEN DIAGNOSIS

An Orientation in the Basic Principles of Diagnosis by the Roentgen Method

by Leo G. Rigler, B.S., M.B., M.D.

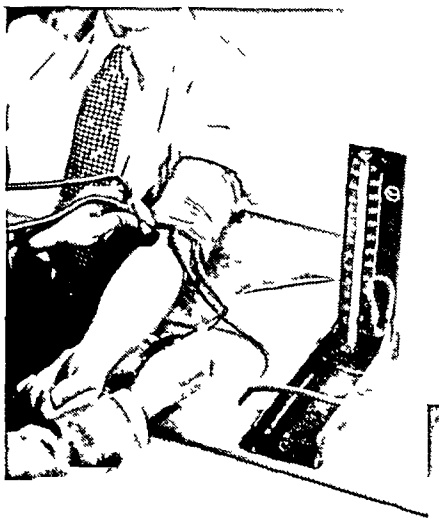
Professor of Radiology, University of Minnesota, Minneapolis

Medical Arts Bldg, Montreal **J. B. LIPPINCOTT COMPANY** *Washington Square, Philadelphia*

Please mention ANNALS OF SURGERY when writing advertisers

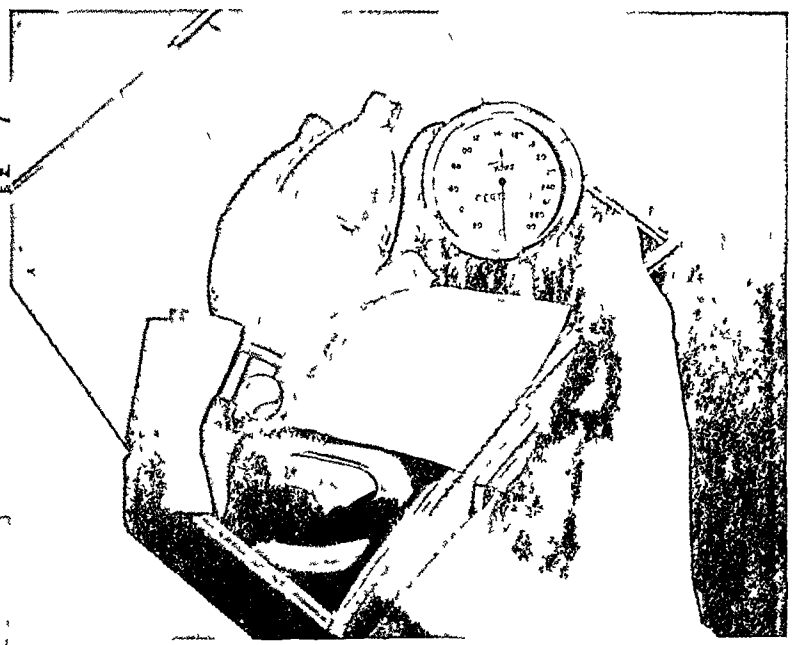
LIKE TO SAVE $5.00?

Tycos Exchange Plan tells you how and brings you most modern blood pressure equipment with iron-clad guarantee on accuracy and durability

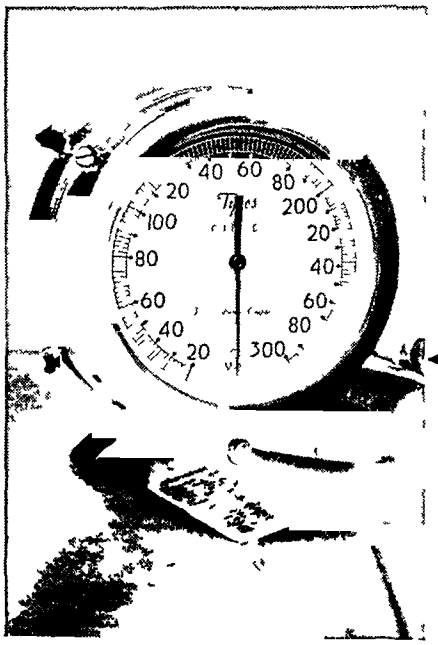


HUNDREDS OF DOCTORS have taken advantage of the Tycos Exchange Plan since it was first offered the medical profession They've exchanged their old sphygmomanometers (any make, any age) for up-to-date Tycos Mercurials or Aneroids

You can still take advantage of this Exchange Plan It is still in effect on the purchase of any of the three instruments shown here See your surgical supply dealer for full details He will make it easy for you to profit by the Plan *Taylor Instrument Companies*, Rochester, N Y Also Toronto, Canada



TYCOS MERCURIAL Amazingly durable Glass tube so reinforced that tests prove it practically unbreakable Only mercurial with case GUARANTEED against breakage! 10-Year Guarantee also covers breakage or mechanical failure of any part except inflation system No time limit on guarantee of accuracy $27 50 complete



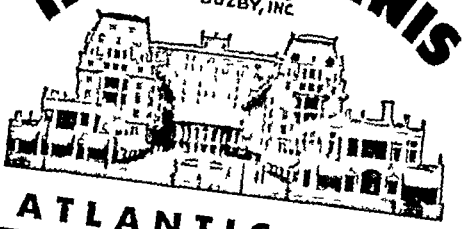
CERTIFIED TYCOS ANEROID This Certified Tycos never requires testing It is guaranteed to be accurate as long as the pointer stands INSIDE any part of the zero oval at bottom of the dial, and to REMAIN ACCURATE IN NORMAL USE If ever thrown out of adjustment, this Certified Tycos will be readjusted WITHOUT CHARGE for ten years $25 00 Complete

DESK-MODEL TYCOS Smart-looking instrument occupying only four inches of desk space Easily read at distance of six feet Carries same 10-Year Guarantee as Portable Tycos Aneroid Also included under Tycos Exchange Plan Available as Wall Model by replacing desk base with wall mounting $27 50 complete

CERTIFIED *Tycos* INSTRUMENTS —10-Year Guarantee

Why Physicians prescribe the

℞ HOTEL DENNIS
WALTER J BUZBY, INC



ATLANTIC CITY

Not alone for its restful atmosphere and reputation for catering to the wants of discriminating people does HOTEL DENNIS receive the recommendation of the medical fraternity, but for these plus services

DIET

Separate and completely equipped diet kitchen managed by trained dietitian
Special Kitchens for use of private nurses

•

HEALTH BATHS

Steam Baking Cabinet Baths Salt Glow
Shower Baths Scottish Douche
Body Massage Swedish Exercises

•

SUN AIDS

Super Sun
Super Sun Tan
Infra-Red Baking
Open-air Sun Decks
Solaria

•

Beachfront location, restricted clientele, Modern, Moderate, Meticulous

•

Rates upon request

HOTEL DENNIS

On the Ocean at Michigan Ave., 3 Blocks from Union Station & Auditorium



Enjoy the Comfort and Prestige of

PHILADELPHIA'S FOREMOST HOTEL

Treat yourself to the best when you visit Philadelphia stop at the Benjamin Franklin Big, comfortable rooms with every modern comfort Enjoy food that's an epic for epicures Save time and annoyance through the Benjamin Franklin's convenient location Yet all this costs you no more than ordinary hotel comfort and service



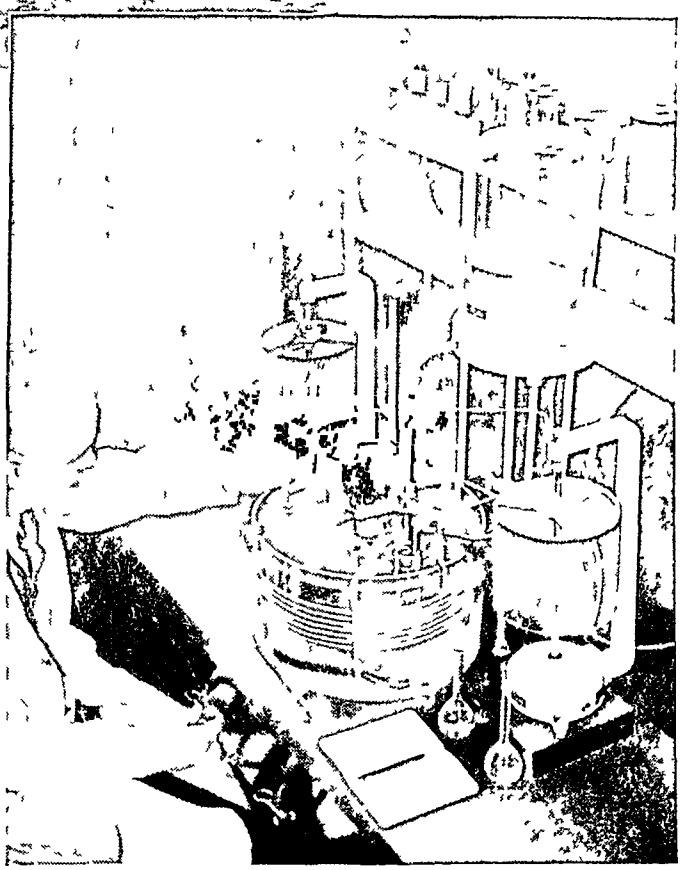
The **BENJAMIN FRANKLIN**

PHILADELPHIA'S FOREMOST HOTEL

Samuel Earley • MANAGING DIRECTOR

The Guinea Pig Helps Deliver





ARMOUR Pituitary Liquid (Posterior Lobe) is effective as an aid in delivery because it stimulates contractions of the uterus Have you ever stopped to think how important it is that you be able to predict the patient's reactions to a given amount of Pituitary Liquid? The different reactions of different patients cause enough variation to guess about. suppose the potency of the Pituitary Liquid itself were not standardized!

That's where the guinea pig comes in The uterus of a guinea pig, when stimulated by Pituitary Liquid, contracts very much as the human uterus does and these contractions are a whole lot easier to measure. To determine the potency of Armour Pituitary Liquid we actually *do* measure the contractions of a guinea pig uterus We do this on samples of every batch The potency must be within certain specific limits which are set as standard

That's what we mean when we say Armour Pituitary Liquid (Posterior Lobe) is *Standardized on the Guinea Pig Uterus for its Oxytocic Potency* That's one of the reasons you can rely on its uniformity and potency

THE ARMOUR LABORATORIES

Headquarters for Medicinals of Animal Origin

ARMOUR AND COMPANY • UNION STOCK YARDS • CHICAGO

Please mention ANNALS OF SURGERY when writing advertisers

DISABILITY EVALUATION

By Earl D. McBride, M.D., F.A.C.S.

Assistant Professor of Orthopedic Surgery, University of Oklahoma School of Medicine

Dr McBride discusses for the industrial physician those injuries most often encountered, and by *analysis of function*, gives a method or guide to the measurement of disability following single or multiple injuries Much attention is given to examinations, signs and symptoms, as well as to the disabilities of the member Ankylosis of the various members and joints of the body are discussed in unusual detail Fractures are considered and in every case 'Compensatory Possibilities" are given The *Industrial Back* is discussed and accuracy of diagnosis is stressed as essential to detect malingering and exaggeration

Symptoms, the influence of anatomic variations, complications and treatment of each condition are covered There is given an excellent table on differential diagnosis points and proven methods for evaluating permanent disability and estimating compensatory possibilities New second edition 623 pages 374 illustrations $8 00

(Price of Lippincott Medical Books Slightly Higher in Canada)

Washington Square Philadelphia **J. B. LIPPINCOTT COMPANY** Medical Arts Bldg Montreal

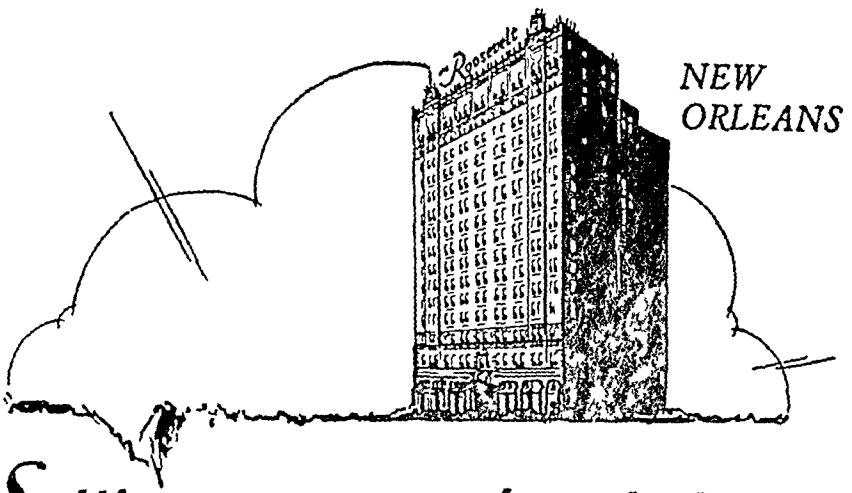
Drink

Coca-Cola

Delicious and Refreshing



Pure refreshment



Setting a standard in

HOTEL ACCOMMODATIONS

Leadership always carries with it the obligation to be more, to do more and give more

As applied to The Roosevelt, New Orleans, leadership means a completely equipped hotel where the traveler finds refinements and luxuries that add so much to the comfort and pleasure of his stay It means better accommodations and service, and finer food for the dollars you spend 800 rooms with bath Moderate rates

Write or Wire Reservations
JAS PAT O'SHAUGHNESSY V-P & Gen Mgr

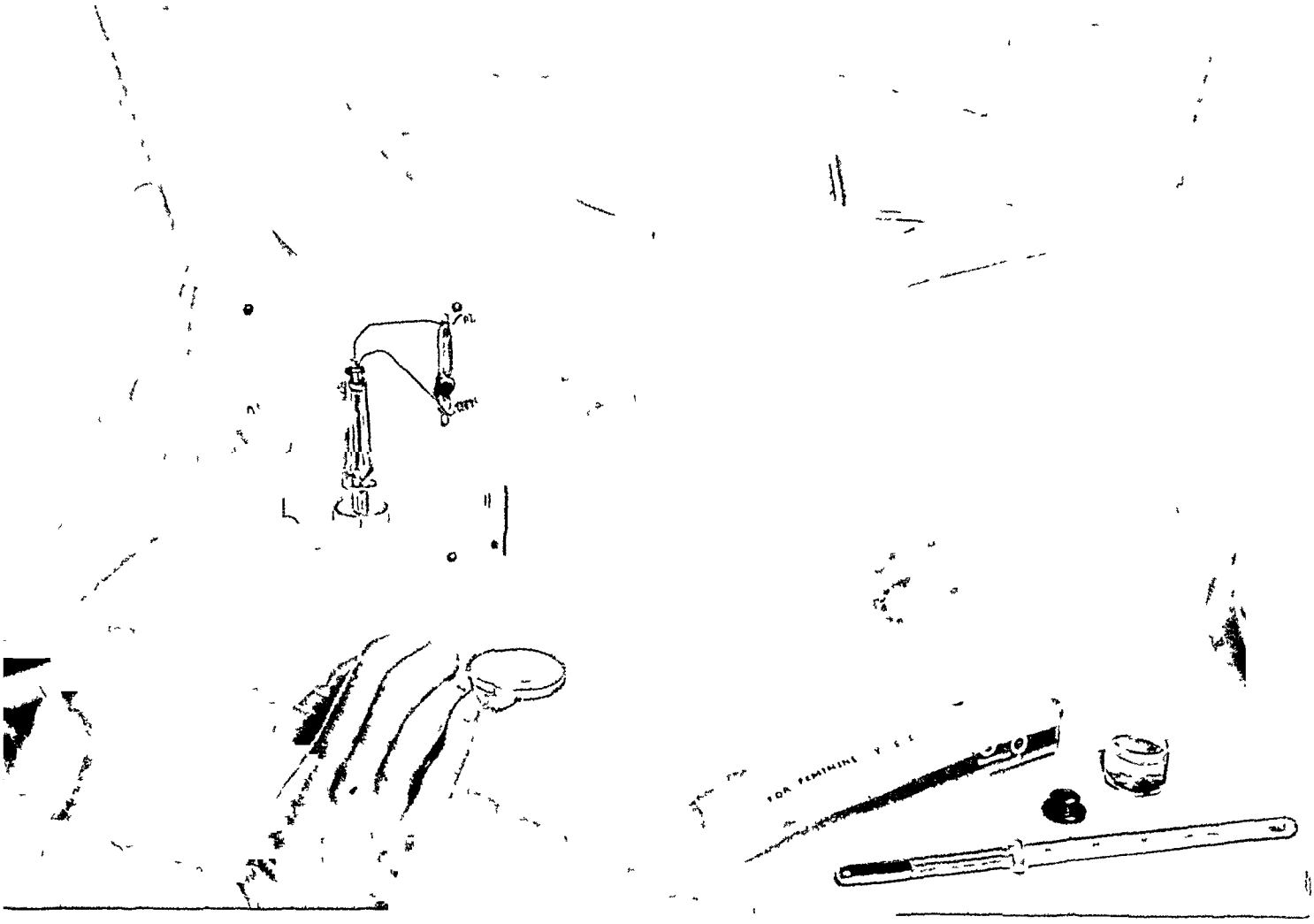
Order Pralines by Mail

Full halves of selected Louisiana Pecans in a luscious layer of pure Louisiana Cane Sugar New Orleans' famous Candy, made from the recipe of the Old Plantation Mammy Two attractive gift boxes



Souvenir Cotton Bale Package, 10 Pralines for $1 75 Postage paid
Plantation Mammy Package, 12 Pralines $1 50 Postage paid
Send Money Order or personal check with order to *The Roosevelt Hotel* New Orleans

The Roosevelt
HOTEL
"Pride of the South"



pH CONTROL

The pH of Ortho-Gynol approximates normal vaginal acidity and is checked by the glass electrode meter Without disturbing effectiveness, the moderately low pH of Ortho-Gynol tends to avert irritation sometimes caused by lower pH levels

A PRODUCT OF JOHNSON & JOHNSON

COPYRIGHT 1938 JOHNSON & JOHNSON

VOL 107 JUNE, 1938 NO 6

ANNALS of SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

Also the Official Publication of the American Surgical Association, the Southern Surgical Association, Philadelphia Academy of Surgery, and New York Surgical Society

EDITORIAL BOARD

WALTER E LEE, M D
Chairman, *Philadelphia*

BARNEY BROOKS, M D
Nashville, Tenn

E D CHURCHILL, M D
Boston, Mass

EVARTS A GRAHAM, M D
St Louis, Mo

ROSCOE R GRAHAM, M D
Toronto, Canada

SAMUEL C HARVEY, M D
New Haven, Conn

ROY D McCLURE, M D
Detroit, Mich

GEORGE P MULLER, M D
Philadelphia

H C NAFFZIGER, M D
San Francisco, Cal

D B PHEMISTER, M D
Chicago, Ill

W F RIENHOFF, JR, M D
Baltimore, Md

A O WHIPPLE, M D
New York

JAMES TAFT PILCHER, M D, Managing Editor

J B LIPPINCOTT COMPANY, *Publishers*

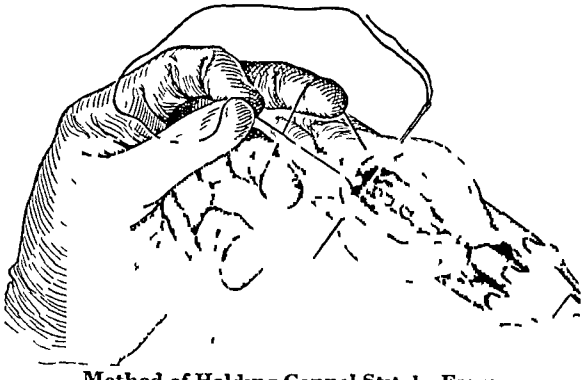
PHILADELPHIA MONTREAL LONDON NEW YORK

Entered at the Post Office at Philadelphia and admitted for transmission through the mails at second class rates Price $10 00 a year Copyright 1938, by J B Lippincott Company, 227–231 South Sixth Street Printed in U S A

CONTENTS—*Continued*

UVEOPAROTITIS	Alfred Stengel, Jr, M D Philadelphia Pa	1000
SPIVACK'S GASTROSTOMY	David H Wagner, M D Chicago Ill	1005
ENDOMETRIOSIS OF THE RECTUM AND SIGMOID	James D Schofield, M D Harry E Bacon, M D Philadelphia Pa	1022
EARLY CARDIAC DECOMPENSATION IN TRAUMATIC ARTERIOVENOUS ANEURYSMS	James M Mason, M D George S Graham, M D Birmingham Ala Jasper D Bush, M D Decatur Ala	1029
MEMOIR		
DANIEL FISKE JONES	Arthur W Allen, M D	1037
BOOKS RECEIVED		1040
INDEX		1041

Actual Practice in Surgical Technique



Method of Holding Connel Stitch From Principles of Operative Surgery, by A V Partipilo, M D

Special Courses—

Urology Cystoscopy Orthopedic Surgery Thoracic Surgery Surgical Pathology Laboratory Diagnosis and Technique Bronchoscopy Eye, Ear, Nose, and Throat Goiter Surgery Gynecology Surgical Anatomy Proctology

Visitors always welcome

CHICAGO POST-GRADUATE SCHOOL OF SURGERY

(Formerly—Laboratory of Surgical Technique)

(Incorporated not for profit)

Near Cook County Hospital

1 Two Weeks Surgical Technique Course rotary course continued throughout the year Combines Clinical Teaching and ACTUAL PRACTICE BY THE STUDENTS under competent supervision A review of the necessary Surgical Anatomy is embraced in the work

2 General Surgery One to Three Months Course designed for students who wish to review more thoroughly Anatomy, Surgical Pathology Surgical Technique and Clinical Surgery

3 Special instruction and practice in the technique of one or more operations is available to surgeons who wish to review the Anatomy and Technique of certain operations

Personal Instruction Actual Practice Operating Rooms, Equipment and Method of Teaching Ideal and Unsurpassed For information as to Courses, Fees, Registration Requirements, Etc, address

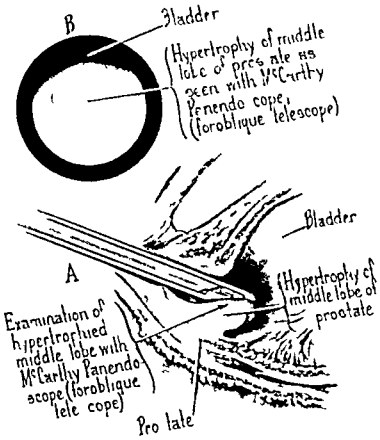
A V PARTIPILO, M D, F A C S, Director, 1950 S Ogden Ave, Chicago, Ill, Phone Haymarket 7044

Please mention ANNALS OF SURGERY when writing advertisers

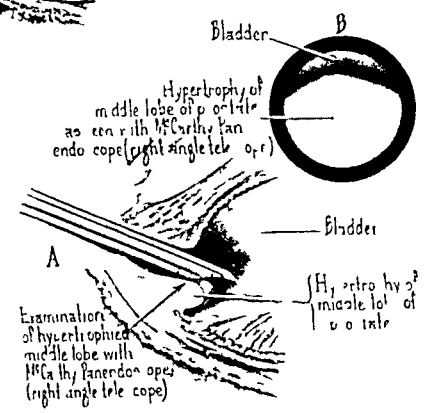
McCarthy Foroblique Pan-endoscope

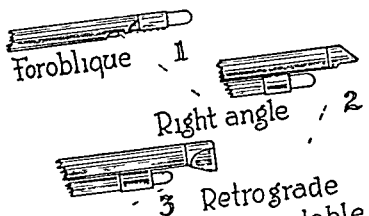
This appropriately named cystoscope possesses such broad utility that it has become one of the most widely used instruments in urology

Essentially the armamentarium consists of straight sheaths, a foroblique telescope and a bridge assembly for relating these elements Sheaths are available in sizes 16 to 30 Fr The telescope is the well-known McCarthy Foro blique* system noted for its natural, amphitheatre", visual characteristics Supplementary retrograde and right angle examining telescopes are also available for detailed inspection of all parts of the bladder and prostatic orifice



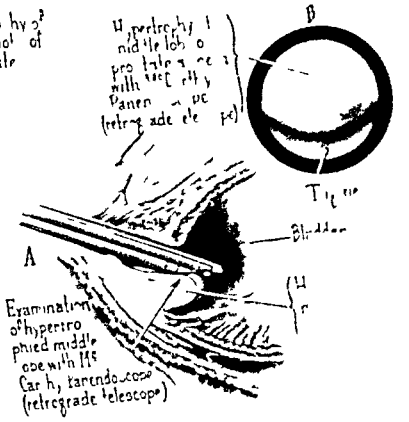
The illustrations are part of a series admirably executed by Mr William P Deutsch showing the technique of the Pan endoscope The entire series and a complete description of the instrument and its accessories will be furnished upon request





Angles of visual field available

The sketch at the left illustrates the angle of vision afforded by the three types of telescopes The sectional views above and at the right show clearly the possibilities of accurately interpreting the extent of prostatic hypertrophy and its relation to the vesical orifice



* Foroblique is our registered trade mark to designate our obliquely forward visual telescopic system

BY REINHOLD H WAPPLER

ESTABLISHED IN 1900

FREDERICK C. WAPPLER PRESIDENT

AMERICAN CYSTOSCOPE MAKERS, INC

NEW YORK, U. S. A.

484 WHITLOCK AVE

The Journal of Bone and Joint Surgery

The Official Publication of the
American Orthopaedic Association
British Orthopaedic Association
American Academy of Orthopaedic Surgeons
Owned and published by the American Orthopaedic Association

Published Quarterly:
January, April, July, and October

The only publication in English dealing exclusively with bone and joint conditions

Through the cooperation of its Foreign Editors, its pages include contributions from recognized leaders in this specialty from foreign countries as well as from the United States and Canada

In the choice of papers for publication emphasis is laid on the practical and clinical subjects

A journal of value to general surgeons as well as to those dealing with the problems of orthopaedic and traumatic surgery

Editor, E. G. BRACKETT, M.D.
8 THE FENWAY, BOSTON, MASSACHUSETTS, U. S. A.

ORDER BLANK

THE JOURNAL OF BONE AND JOINT SURGERY
8 The Fenway Boston, Massachusetts

Please enter my subscription to THE JOURNAL OF BONE AND JOINT SURGERY for one year beginning with the issue for

☐ Enclosed find $——— in payment ☐ Will remit on receipt of bill

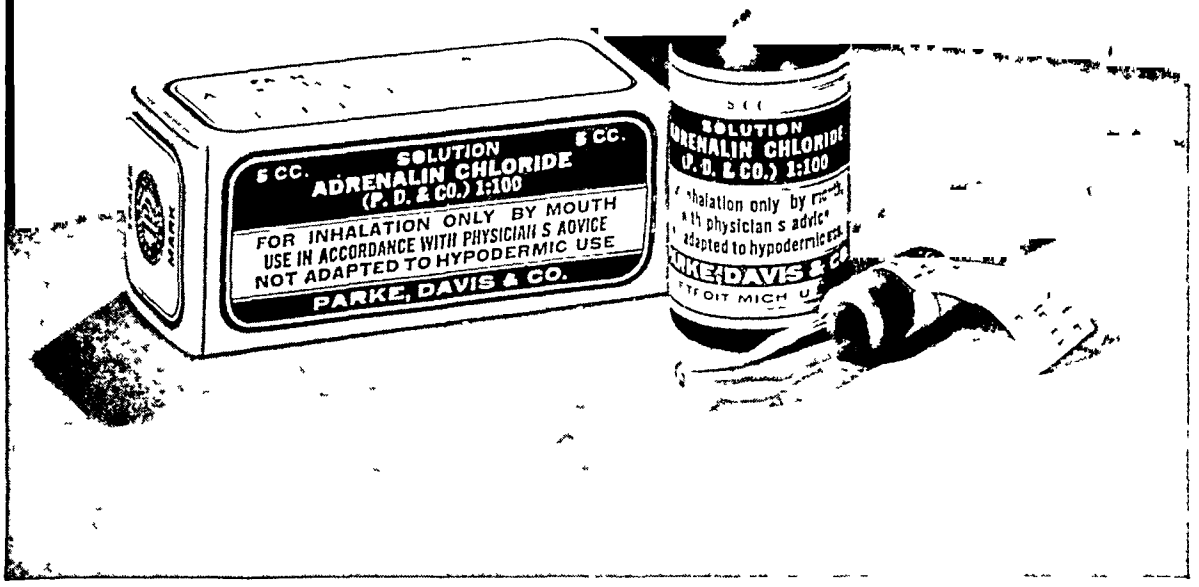
NAME STREET

CITY STATE

Subscription Price—Payable in Advance—$5.00 in the United States $5.25 in Canada $5.75 in Foreign Countries

Please mention ANNALS OF SURGERY when writing advertisers

TREATMENT OF BRONCHIAL ASTHMA BY ORAL INHALATION



ADRENALIN CHLORIDE SOLUTION 1:100

THE oral inhalation of Adrenalin Chloride Solution 1 100 is promptly effective in relieving symptoms of bronchial asthma—in most cases results have been quite as satisfactory as those following hypodermic injection of the familiar 1 1000 solution. Nervousness and tachycardia, as well as other reactions which often accompany parenteral administration, are much less frequent following inhalation therapy. Discomfort and inconvenience of hypodermic injection are obviated by this new treatment.

Adrenalin is the Parke-Davis brand of Epinephrine U S P Adrenalin Chloride Solution 1 100 is accepted by the Council on Pharmacy and Chemistry of the American Medical Association, it is supplied in 5-cc vials, together with dropper for transferring the solution to a suitable atomizer, vaporizer, or nebulizer The apparatus used must deliver a fine spray entirely free from drops

PARKE, DAVIS & COMPANY · DETROIT

The World's Largest Makers of Pharmaceutical and Biological Products

The GRÜSS Rethreadable NEEDLE

SUTURE INSERTED THREADING COMPLETED



TRIAL OFFER Write today for 1 dozen needles on approval If not returned to us in 30 days we will mail bill Please state types of needles desired

SECURELY HOLDS A SINGLE SUTURE

Gruss Continuous Suture Needles reduce trauma to such an extent that largest needles with coarsest silkworm gut may be passed through tissue without aid of forceps Suture is held so firmly that hazard of loss during use is entirely eliminated May be *rethreaded* Types and sizes for all uses, all sutures

DEPT D

GRÜSS SURGICAL MFG. CO.

163 SECOND STREET, SAN FRANCISCO, CALIFORNIA

Ravdin and Coates Translation

OPERATIVE SURGERY

VOL. III: The Ear, Nose, Pharynx, Larynx, Trachea, Bronchi, Esophagus and Neck

The newest volume (June 1937) in what surgeons generally consider the outstanding surgical series of our times Covers the surgery of the ear and respiratory passages, together with that of the neck, the esophagus and cervical areas, with highly significant discussion of the thyroid gland and thymus, exophthalmic goiter and other subjects for surgical intervention on the head and upper body Every detail for operative procedure is beautifully illustrated and clearly described 459 illustrations, mostly in color 528 pages $12 00

Edited by **MARTIN KIRSCHNER, M.D.**

Professor of Surgery and Director of the Surgical Clinic,
University of Tubingen, Germany

Washington Square Philadelphia **J. B. LIPPINCOTT COMPANY** Medical Arts Bldg Montreal

INDEX TO ADVERTISERS

	Page
SURGICAL SUPPLIES	
American Cystoscope Makers, Inc	5
Ciba Pharmaceutical Products, Inc	Back Cover
De Puy Mfg Co	19
Gruss Surgical Mfg Co	8
Kny-Scheerer Corporation	Inside Back Cover
George P Pilling & Son Co	0
LIGATURES	
Davis & Geck, Inc	16
Davis & Geck, Inc	Insert 8-9
Johnson & Johnson	15, 24
C De Witt Lukens	16
PHARMACEUTICAL SUPPLIES	
Anglo-French Drug Co , Inc	Inside Front Cover
Cutter Laboratories	3
Drake & Blackstone	22
E Fougera & Co , Inc	17
Eli Lilly & Company	13
Loeser Laboratory	Back Cover
Parke Davis & Company	7
Petrolagar Laboratories Inc	10
Purdue Frederick Company	Inside Back Cover
E R Squibb & Sons	11
Winthrop Chemical Co , Inc	12
HOTELS	
Benjamin Franklin	19
Chalfonte-Haddon Hall	9
Hotel Dennis	20
Hotel Roosevelt	23
PUBLISHERS	
Journal of Bone and Joint Surgery	6
Lea & Febiger	18
J B Lippincott Company	8, 14, 20 21
SCHOOLS	
Chicago Post-Graduate School of Surgery	4
Cook County Graduate School of Medicine	19



TO DO ONE THING WELL

To produce a suture which excels both in physiologic integrity and mechanical refinement calls for technical control, experience, and craftsmanship of a type not easily acquired It is a work which well deserves the full time and attention of an organization created solely for this purpose.

D & G SUTURES

THIS ONE THING WE DO

DAVIS & GECK, INC , BROOKLYN, NEW YORK, U S A.

Special D&G Sutures

WITH SWAGED-ON ATRAUMATIC NEEDLES

THIS group of products comprises over a hundred suture and needle combinations specially designed for specific procedures, particularly those in which minimized suture trauma and the convenience of needles which cannot possibly become unthreaded, are desirable A few products from this group are shown on these pages Full information on others may be obtained from your dealer or by mail from us, upon request

Intestinal Sutures

KALMERID plain or chromic catgut, celluloid-linen or silk with Atraumatic needles in the several types indicated integrally affixed Suture lengths 36 inches for products 1342, 1352, 1372 and 1542, all others 28 inches

THERMO-FLEX *(non-boilable)*

Plain Catgut

NO		NEEDLE	DOZEN
1501	Straight Needle	A-1	$3 60
1503	3/8-Circle Needle	A-3	4 20
1504	Small 1/2-Circle Needle	A-4	4 20
1505	1/2-Circle Needle	A-5	4 20

20-Day Chromic Catgut

1541	Straight Needle	A-1	$3 60
1542	Two Straight Needles	A-1	4 20
1543	3/8-Circle Needle	A-3	4 20
1544	Small 1/2-Circle Needle	A-4	4 20
1545	1/2-Circle Needle	A-5	4 20

CLAUSTRO-THERMAL *(boilable)*

Plain Catgut

1301	Straight Needle	A-1	$3 60
1303	3/8-Circle Needle	A-3	4 20
1304	Small 1/2-Circle Needle	A-4	4 20
1305	1/2-Circle Needle	A-5	4 20

20-Day Chromic Catgut

1341	Straight Needle	A-1	$3 60
1342	Two Straight Needles	A-1	4 20
1343	3/8-Circle Needle	A-3	4 20
1344	Small 1/2-Circle Needle	A-4	4 20
1345	1/2-Circle Needle	A-5	4 20

Intestinal Sutures *(cont'd)*

Celluloid-Linen

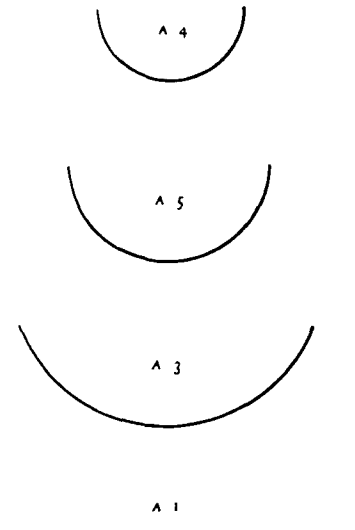
NO		NEEDLE	DOZEN
1351	Straight Needle*	A-1	$3 60
1352	Two Straight Needles*	A-1	4 20
1354	Small 1/2-Circle Needle*	A-4	4 20

Black Silk

1371	Straight Needle*	A-1	$3 60
1372	Two Straight Needles*	A-1	4 20
1374	Small 1/2-Circle Needle*	A-4	4 20

Sizes 00 0 1, except *00 0 only

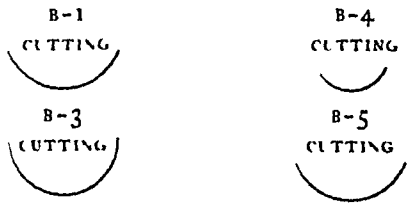
In packages of 12 tubes of a kind and size



DIAMETERS 022 TO 026

Eye Sutures

FINE sizes of plain, 10-day chromic catgut, and black silk with small Atraumatic needles Suture length 18 inches except as noted Boilable

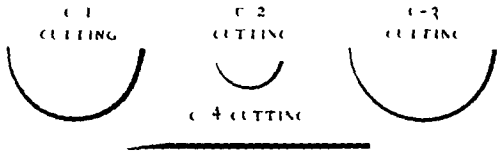


NO	MATERIAL	SIZE	NEEDLE
1661	Black Silk	6-0	B-3
1663	Plain Catgut	4-0	B-5
1665	Black Silk	6-0	B-1
1665	Black Silk	4-0	B-1
1667	Plain Catgut	3-0	B-4
1669	10-Day Catgut	4-0	B-5
1669	10-Day Catgut	3-0	B-5
1669D	10-Day Catgut†	4-0	B-5
1669D	10-Day Catgut†	3-0	B-5
	DOUBLE ARMED		
1662	Black Silk *	6-0	B-3
1664	Black Silk *	6-0	B-1
1664	Black Silk *	4-0	B-1
1666	Plain Catgut *	3-0	B-4
1668	10-Day Catgut *	4-0	B-5
1668	10-Day Catgut *	3-0	B-5
1668D	10-Day Catgut †	4-0	B-5
1668D	10-Day Catgut †	3-0	B-5

* 12 inches † 9 inches

Package of 12 tubes of a kind $4 20

Cleft Palate and Harelip Sutures



NO	MATERIAL	SIZE	NEEDLE
1751	Kal-dermic	00	C-1
1752	Aluminum-Bronze Wire	00	C-1
1753	Black Braided Silk	000	C-2
1754	Aluminum-Bronze Wire	00	C-4
1755	Kal-dermic	00	C-3
1758	Aluminum-Bronze Wire	00	C-3

Suture length 18 inches

Package of 12 tubes of a kind $4 20

Thyroid Sutures

THERMO-FLEX (*non-boilable*) or Claustro-Thermal (*boilable*) catgut, and black braided silk with half-circle, taper point Atraumatic needles Suture length 28 inches

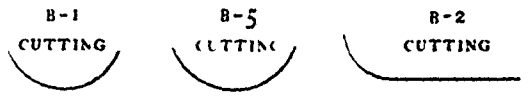


NO	MATERIAL	SIZE	NEEDLE
1635	Non-Boilable Plain Catgut	0	T-1
1625	Boilable Plain Catgut	0	T-1
1624	Black Braided Silk	000	T-2

Package of 12 tubes of a kind $4 20

Plastic Sutures

FINE sizes of Kal-dermic, silk and silkworm gut with small, cutting point Atraumatic needles Suture length 18 inches Boilable



NO	MATERIAL	SIZE	NEEDLE
1651	Kal-dermic	8-0	B-1
1651	Kal-dermic	6-0	B-1
1652	Kal-dermic	8 0	B-5
1652	Kal-dermic	6-0	B-5
1652	Kal-dermic	4-0	B-5
1653	Black Silkworm	4-0	B-1
1655	Kal-dermic	4-0	B-2
1658	Black Silk	4-0	B-2

Package of 12 tubes of a kind $4 20

Other D & G Sutures

SPECIAL needled sutures are also prepared for dental, tonsil, circumcision, obstetrical, ureteral, renal, nerve, artery, and emergency work These are in addition to our complete line of unneedled sutures embracing catgut, ribbon gut, kangaroo tendons, and a variety of other non-absorbable materials

DISCOUNTS ON QUANTITIES

DAVIS & GECK, INC , 217 DUFFIELD STREET, BROOKLYN, NEW YORK

Copyright 1938 Davis & Geck, Inc Printed in U S A



DIONYSIO DACA CHACON (1510-1596) was born in Valladolid, Spain, started to practice surgery at the age of twenty and later became personal physician to Charles V and Philip II. He wrote extensively on all aspects of surgery. His "*Tratado de Cirujia*" contains a special chapter on sutures and ligatures, and gives an interesting account of difficulties encountered through the necessity of maintaining a kneeling position while operating on royalty.

D&G Sutures

"THIS ONE THING I DO"

DAVIS & GECK INC



PATIENTS deserve a VACATION too!

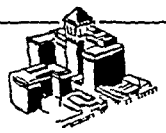
Send them away from the sick-room to the salubrities of the sea Prescribe fresh mornings of "chairing" or walking along the Boardwalk at our door Prescribe afternoons on our shady Ocean Decks (near the elevators), evenings of music, nights of cool, strengthening sleep Prescribe tempting meals, the Chalfonte-Haddon Hall kind! (Diet patients expertly catered to)

We'll make your "medicine" all the pleasanter to take with friendly, considerate treatment Central location, yet quiet Restricted clientele

LEEDS AND LIPPINCOTT COMPANY

CHALFONTE-HADDON HALL

ATLANTIC CITY

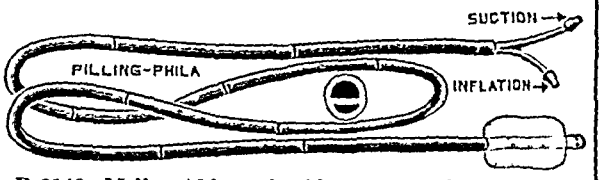


PILLING

MILLER-ABBOTT DOUBLE LUMEN TUBES

FOR SMALL INTESTINAL INTUBATION

T Grier Miller, M D , and W Osler Abbott, M D

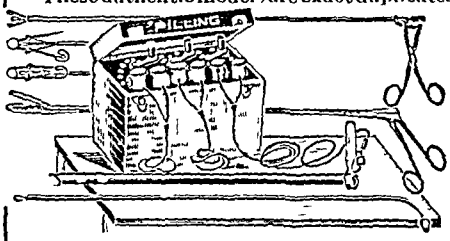


P 9140—Miller-Abbott double lumen tube, Style II
$7 50

Described in
Surgery, Gynecology and Obstetrics
April, 1938
"Intubation Studies
of the
Human Small Intestine"
by
W. Osler Abbott, M.D.
and
Charles G Johnston, M D., F.A C S.
Circular on request

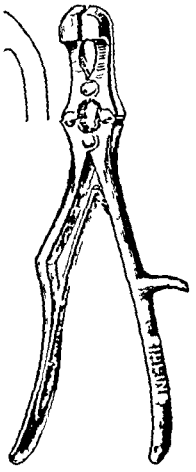
BRONCHOSCOPY

Pilling-Made Equipment Used by the Staff of the Chevalier Jackson Clinics



These authentic models are exact duplicates of those made by us for and used by the various Chevalier Jackson Clinics in Philadelphia All made under our one roof and supervision, insuring proper inter-functioning of separate instruments

INSTRUMENTS FOR



THORACOPLASTY
THORASCOPY
PNEUMOLYSIS
PHRENICECTOMY
LOBECTOMY
PNEUMOTHORAX
DECOMPRESSION

SEND FOR LITERATURE



Bronchoscopic Catalog on Request

GEORGE P PILLING & SON CO
Arch & 23rd Philadelphia



» » EXERCISE « «

Exercise is one of the important factors in the treatment of constipation Of equal importance are suitable diet and a regular habit time for bowel movement Unfortunately, under the present mode of living, such strict regimen is difficult to enforce While your patient may be inclined to forsake suitable diet and exercise, it is imperative that a daily bowel movement be maintained Petrolagar assists in establishing a normal bowel movement as it mixes intimately with the feces to form a soft easily passed stool By the use of Petrolagar habit time may be readily established and maintained

Petrolagar is a mechanical emulsion of pure liquid petrolatum (65% by volume) and agar agar Accepted by the Council on Pharmacy and Chemistry of the American Medical Association for the treatment of constipation

Petrolagar



In Anesthesia

WHEN A HIGH OXYGEN LEVEL IS OF VALUE...

USE

Cyclopropane Squibb

GRIFFITH[1] states "My conception of anesthesia with the older gases is that we administer the gas, plus enough oxygen to keep the patient alive and in good condition With Cyclopropane, on the other hand, we administer oxygen with just enough of the anesthetic gas to keep the patient asleep"

The abundance of oxygen which may be given with Cyclopropane makes it a valuable anesthetic agent for use in thyroid and thoracic surgery as well as in cases exhibiting symptoms of respiratory obstruction, anemia, debility, and shock Breathing is quiet Circulation is not depressed and relaxation is satisfactory for most surgical procedures

The thorough purification methods used in the manufacture of Cyclopropane Squibb results in an exceptionally pure gas Anesthetists throughout the country have generally accepted it as a dependable anesthetic agent

Cyclopropane Squibb is supplied in 30-, 75-, and 200-gallon cylinders and in 2-, 6-, and 25-gallon Amplons* The AA, B, and D Squibb cylinders are made of special thin steel They are light in weight, yet comparable in strength to the old standard cylinders

NOTE Cyclopropane is a highly potent gas and should be used only by anesthetists who are familiar with the technique of its administration

For information and booklet on Cyclopropane address the Anesthetic Division, 745 Fifth Avenue, New York

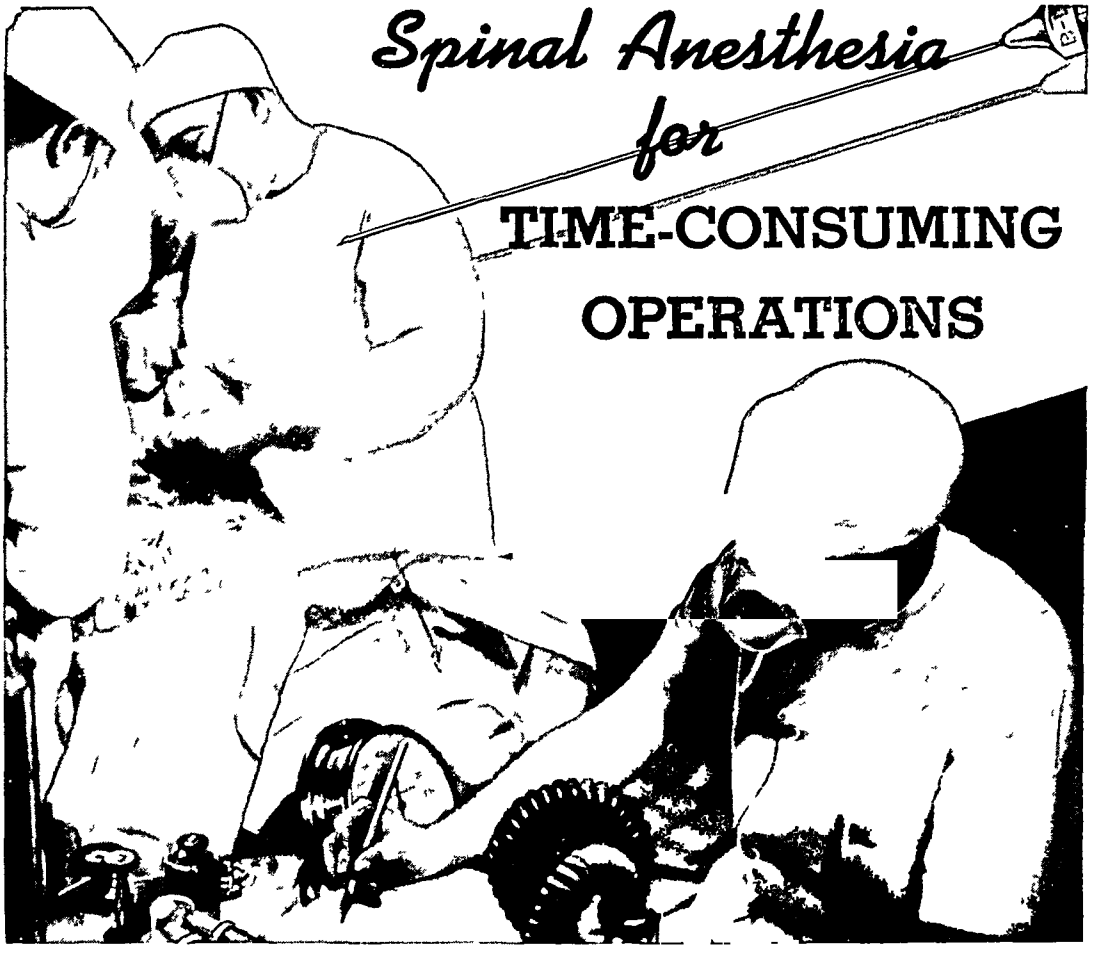
[1] Griffith H R Cyclopropane Anesthesia *Canad M A J* 31 157 August, 1934

*Amplon is a trade mark of E R Squibb & Sons

E·R·SQUIBB & SONS, NEW YORK

MANUFACTURING CHEMISTS TO THE MEDICAL PROFESSION SINCE 1858.

Please mention ANNALS OF SURGERY when writing advertisers



WITH Pontocaine Hydrochloride there need be no uneasiness as to the duration of spinal anesthesia since its anesthetic effect extends over two hours This is of particular advantage in resection of the stomach, gastro-enterostomy, gallbladder operations, prostatectomy, bone and joint surgery, operations for malignant tumor of the abdominal and pelvic organs

Moreover, Pontocaine Hydrochloride possesses other qualities which render it very suitable for spinal anesthesia In the majority of cases there is no significant fall in blood pressure Pulse and respiration show no material changes attributable to its action Nausea, if present at all, is of mild character and postoperative headache is infrequent

Supplied in 1 per cent solution in ampules of 2 cc , boxes of 10

•

Write for detailed information on the chemistry, action and use of Pontocaine Hydrochloride

PONTOCAINE

Trademark Reg U S Pat Off & Canada

Brand of TETRACAIN

HYDROCHLORIDE

WINTHROP CHEMICAL COMPANY, INC

Pharmaceuticals of merit for the physician

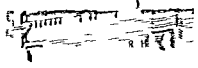
NEW YORK N Y WINDSOR, ONT

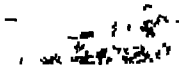
Factories Rensselaer, N Y —Windsor, Ont

568 M

PERSUASION may be ever so forceful, but experience alone engenders true confidence The Lilly Research Laboratories have reason to be glad that the doctor's memory is long, that his judgment is based on results, that his confidence in therapeutic agents depends on fact and not on hearsay Between the medical profession and Eli Lilly and Company there exists a bond of respect that is the natural outgrowth of long years of responsible dealing with each other

'Sodium Amytal' (Sodium Iso-amyl Ethyl Barbiturate, Lilly) is to be recommended as a preanesthetic because it is apparently destroyed in the body The use of this hypnotic is not considered to add to the burden of renal excretion 'Sodium Amytal' is supplied in bottles of 40 and 500 pulvules (filled capsules)





ELI LILLY AND COMPANY
INDIANAPOLIS, INDIANA, U S A

ARTHUR DEAN BEVAN, M D

Says in his FOREWORD:

"This splendid work by Dr Thorek on Surgical Errors and Safeguards should be a welcome addition to the library of every progressive surgeon and advanced medical student"

SURGICAL ERRORS AND SAFEGUARDS

By Max Thorek, M D

Professor Clinical Surgery, Cook County Graduate School of Medicine Foreword by Arthur Dean Bevan, M D, Professor and head of the Department of Surgery, Rush Medical College of the University of Chicago

THIS is a new and different type of surgery, conceived and projected from the vast experiences of the author and his associates It discusses how to avoid complications and technical errors, and how to act when face to face with some of the abnormal circumstances which constantly present themselves during the course of a surgical operation

Rich in illustrations and case histories, this work discusses not only errors and safeguards in connection with surgical operations in general, and pre- and post-operative care of the patient, but failures in surgery, the "bad risk" patient and the errors and safeguards in blood transfusions, operations on the head, neck, thorax, abdomen, in general, stomach, intestinal operations, liver, biliary system, pancreas and spleen, hernia, urinary tract, male genitalia, gynecologic operations, extremities, spinal cord, and failures due to defective instruments and foreign bodies left within the body *No surgeon can afford to be without a copy* 696 pages 668 illustrations Price $10 00 (Slightly higher in Canada)

COMPLETELY REVISED 3rd EDITION

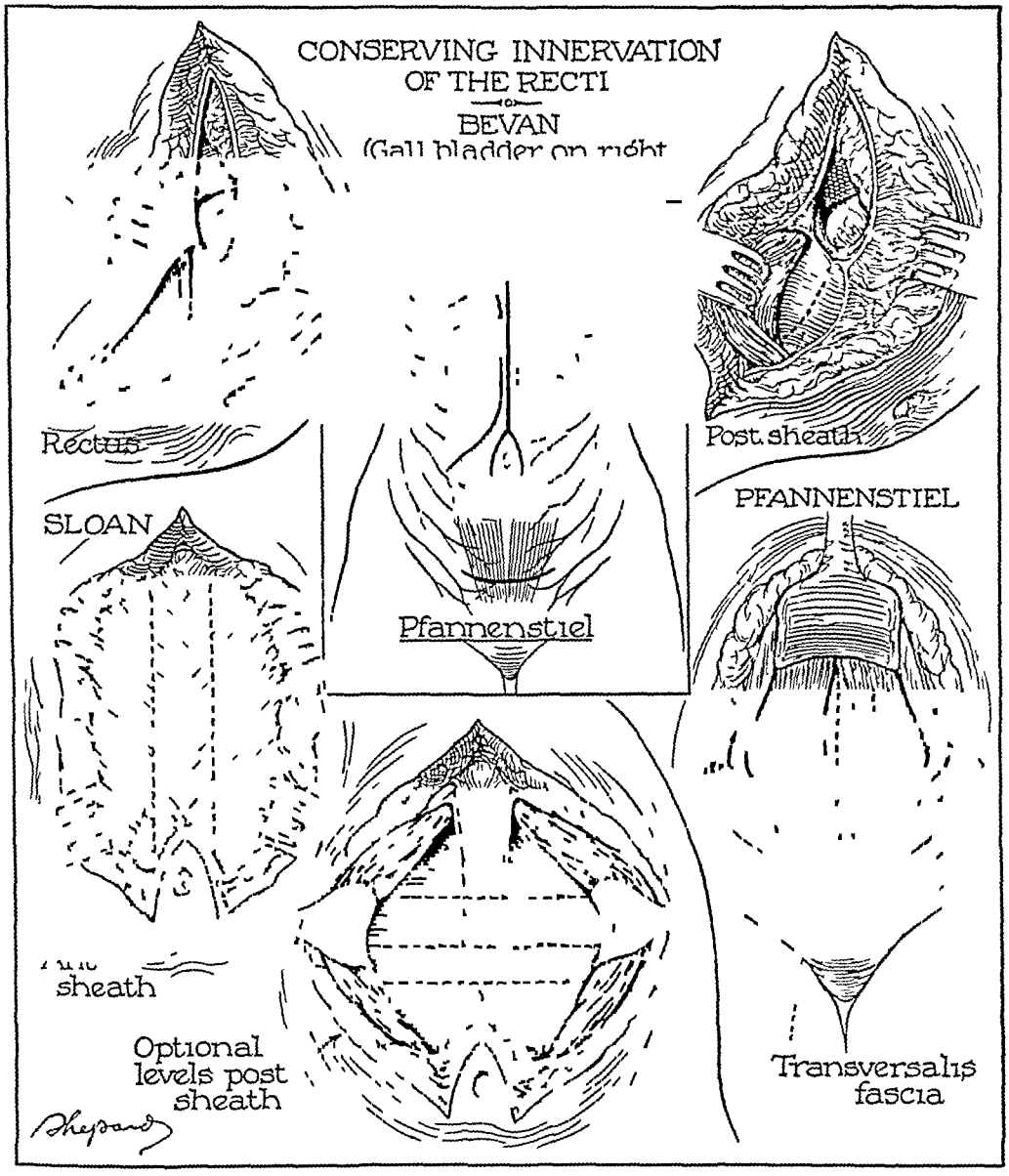
Send for our New Medical Book Catalogue

Washington Square Philadelphia **J. B. LIPPINCOTT COMPANY** Med Arts Bldg Montreal

OPERATIVE PROCEDURE

PLATE NO 82

Abdominal Incisions



Absolute sterilization by heat, without impairment of tensile strength, is the daily production standard of Ethicon Sutures As taken from the sterile tubes, they possess more tensile strength than is required to ligate the largest human blood vessel or to suture the densest human tissue Ethicon Sutures are produced by exclusive procedures, from the raw material to the final stage of packaging and inspection in our laboratories They are supple, smooth and uniform

ETHICON NON-BOILABLE CATGUT SUTURES

JOHNSON & JOHNSON, NEW BRUNSWICK, N J , CHICAGO, ILL.

MANUFACTURERS OF SURGICAL SUTURES SINCE 1887

Lukens Sterile Catgut

TRADE (Bartlett Process) MARK



Make the Test Yourself

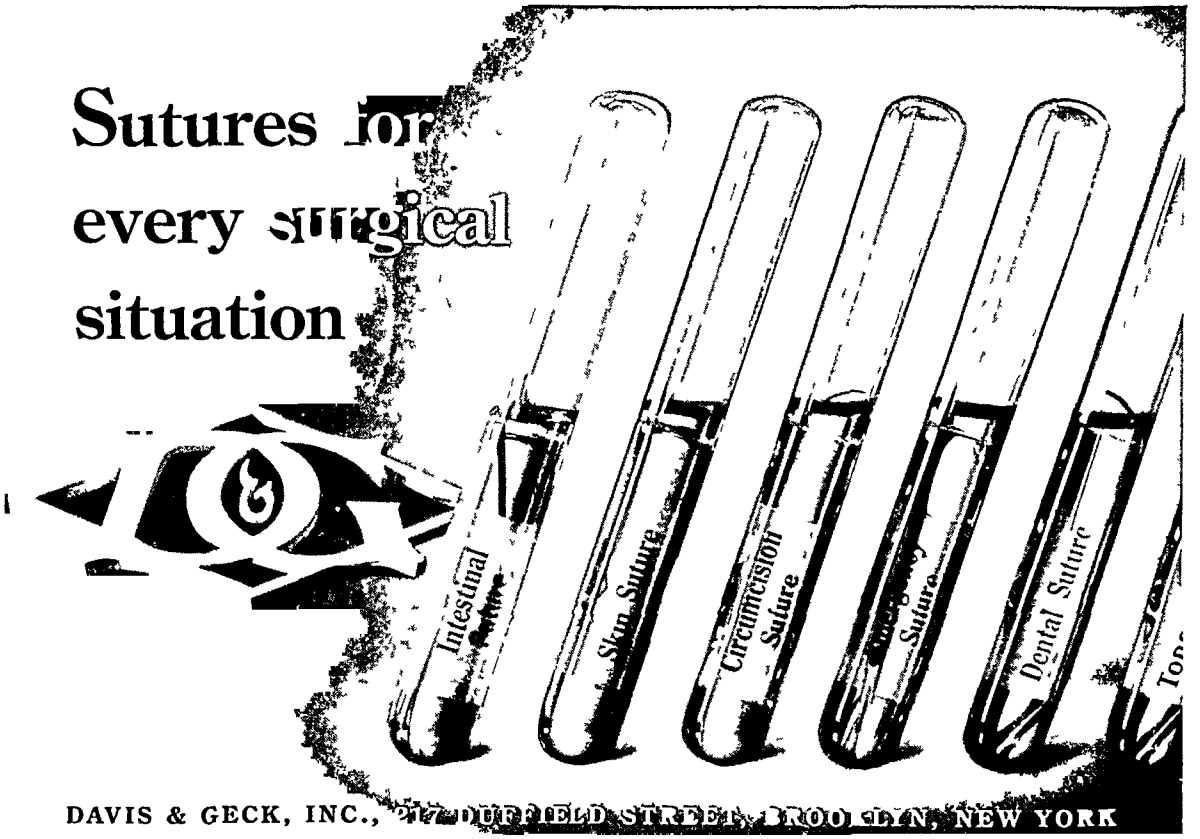
Compare It Point for Point With any Other Catgut

We Will Send the Samples

Sizes 00-4 Plain — Sizes 00-4 Tanned

C. DE WITT LUKENS CO.
4908 Laclede Ave.
ST. LOUIS, MO., U.S.A.

Sutures for every surgical situation



DAVIS & GECK, INC., [illegible] DUFFIELD STREET, BROOKLYN, NEW YORK

ANNALS OF SURGERY

VOL 107 JUNE, 1938 No 6

TRANSACTIONS OF THE SOUTHERN SURGICAL ASSOCIATION

MEETING HELD AT BIRMINGHAM, ALA

December 7, 1937

(CONTINUED)

ADRENAL CORTICAL TUMORS AND THEIR TREATMENT

A STUDY OF SEVEN OPERATED CASES

WALTMAN WALTERS, M D , D Sc

DIVISION OF SURGERY,

AND

EDWIN J KEPLER, M D

DIVISION OF MEDICINE THE MAYO CLINIC

ROCHESTER, MINN

A GROUP of seven consecutive patients who had adrenal cortical tumors and who were operated upon at the Mayo Clinic, at some time during the period from 1924 to 1937, all recovered Two of these patients were operated upon during the past year All seven patients presented, in varying degrees, the signs and symptoms referred to as the "adrenal cortical syndrome" In five of the seven patients, the removal of an encapsulated tumor resulted in prompt regression of symptoms In the other two patients (Cases 2 and 4) the carcinomatous tumor had penetrated the adrenal capsule, and, within a period of 18 months after its removal, the tumor recurred with fatal consequences Since most adrenal cortical tumors producing the syndrome are relatively malignant, but in the early stages are definitely encapsulated, it is important to make the diagnosis early and to remove the lesion before the cells have penetrated the capsule and invaded adjacent structures The similarity of the clinical syndrome, produced by an adrenal cortical tumor, to that described by Cushing called "pituitary basophilism" or "Cushing's disease" may lead to the erroneous decision that pituitary basophilism is present

Submitted for publication February 12, 1938

In view of the fact that treatment of the latter lesion is entirely dependent on roentgenotherapy, from which, in a very few cases, little more than palliative benefit has been obtained, and in view of the fact that adrenal cortical tumors are frequently the cause of a similar syndrome, and that their removal usually can be readily accomplished, we believe that the adrenal gland should be explored if patients present this syndrome, providing their condition permits

Symptoms and Signs—The symptoms produced by a hyperfunctioning tumor of the adrenal cortex depend on the sex and age of the patient at the time the tumor begins to overfunction Thus the clinical picture observed among men is considerably different from that observed among women Also,



FIG 1—(Case 1) (*a*) Showing normal contour of face without hirsutism or acne (*b*) Encapsulated Grade 4 carcinoma of the right adrenal gland

when the disease occurs before puberty the symptoms in either sex are different from those which ensue when the disease occurs after puberty In general, it may be said that the disease among boys results in precocious puberty of the homologous type, that is, the puberty is premature but essentially normal in other respects* Among girls, on the other hand, hyperfunctioning tumors of the adrenal cortex produce precocious puberty of the heterologous type, that is, the puberty in these girls is not only premature but masculine in character For example, the cutaneous distribution of hair is masculine in type, the voice changes, the clitoris may enlarge and resemble a penis, *etc* (Cases 6 and 7, Figs 5 and 6) Among children of either sex growth of bone is rapid and premature, so that the bone age exceeds the chronologic age of the patient

If one is justified in expressing an opinion based upon the five cases re-

* We have been able to find reports in the literature of only 12 proved instances of adrenal cortical tumor in male children To these might be added the case reported by Mainzer,[2] in which there was pyelographic evidence of adrenal tumor Owing to the small number of cases, didactic statements regarding symptomatology are scarcely justified It is significant that puberty did not occur in two of 13 cases, namely, those reported by Guthrie and Emery[3] and by Bertil Josephson[4]

ported in the literature,[1] adrenal cortical tumors of men result in loss of masculinity and in the appearance of feminine characteristics The breasts enlarge, the habitus takes on feminine contours, the beard disappears, the testes and penis decrease in size and cease to function as organs of reproduction

When the disease occurs among young women, as is usual the secondary sexual characteristics tend to become masculine in character Thus, the menses cease, the breasts decrease in size (Case 3), a beard appears, the hair of the extremities, abdomen and back increases in amount and its distribution is masculine in type, and the clitoris undergoes hypertrophy

In addition to changes in the secondary sexual characteristics there are



FIG 2.—(Case 3) (*a*) Appearance of patient's face before operation (*b*) Appearance of patient's face two years after operation

important and interesting associated symptoms which are somewhat common to all cases, regardless of age or sex Among these symptoms and signs are a florid complexion (Case 5, Fig 3*a*), purplish striations of the skin (Fig 3*b*), acne, hypertension, diabetes (either clinical or latent), osteoporosis, weakness and gain in weight

Contrary to what might be expected from our knowledge of Addison's disease, there is usually no marked disturbance in metabolism of electrolytes demonstrable by chemical examination of the blood *

The foregoing brief presentation of the clinical pictures encountered in the study of cases of adrenal cortical tumors corresponds fairly closely to the usual

* In this connection it is interesting that we have had three patients who had hyperplastic adrenal glands who gave evidence of disturbances in metabolism of electrolytes which could not be attributed to other causes McQuarrie and his colleagues have recently reported another similar case No tumor of the adrenal gland was found in any of these four cases

and classic descriptions which have appeared in the literature Unfortunately for diagnostic purposes, many cases encountered do not conform, or conform only slightly, to these classic patterns Thus, in one woman who had a right cortical adrenal tumor the only symptom that occurred was amenorrhea (Case 1), in other instances, it would be necessary to stretch the meaning of the term "virilism" almost to the breaking point to make it fit the clinical picture encountered * As one might expect from theoretic considerations, all cardinal and incidental symptoms vary considerably in different cases depending on the duration of the disease and on the intensity of the pathologic process Of particular significance is the fact that, in a number of cases, especially among women, the clinical picture has not been one of adrenal virilism, but one of pituitary basophilism in all its essential and incidental details In the latter disease mentioned, in which the primary disturbance presumably results from a basophilic tumor of the pituitary body, the habitus is not masculine but of the buffalo obesity type, the clitoris does not enlarge and the patient bears only a superficial resemblance to the almost completely masculinized female suffering from adrenal cortical tumor of long standing The case recently reported by Lukens, Flippin and Thigpen[6] is an excellent example of adrenal cortical tumor masquerading as a basophilic tumor of the pituitary body and the literature contains a number of similar cases in which, unfortunately, after the pituitary body had been treated intensely by roentgenotherapy, the patient died of a metastasizing adrenal cortical tumor

Differential Diagnosis—It should not be inferred from the preceding remarks that adrenal cortical tumors and basophilic tumors of the pituitary body are the only lesions capable of producing reversion of sexual characteristics or precocious puberty For example, hyperplasia of the adrenal cortex (sometimes associated with tumors of the thymus) may produce a clinical picture almost, if not entirely, identical with that seen in cases of pituitary basophilism or adrenal cortical tumor Furthermore, masculinizing tumors of the ovaries (usually arrhenoblastomata, and very, very rarely granulosa cell tumors) result in hirsutism of the male type, amenorrhea, and hypertrophy of the clitoris However, such tumors practically never cause diabetes, hypertension, osteoporosis or the other incidental symptoms associated with adrenal cortical tumors In children, tumors and inflammatory processes in the region of the pineal body and contiguous structures may be associated with sexual and somatic precocity Finally, there are, in addition, many women who have varying degrees of hirsutism, amenorrhea, hypertension, and obesity for which no adequate basis can be found

Pituitary Basophilism and Adrenal Cortical Adenoma—The greatest difficulty in differential diagnosis is encountered in women, owing to the similarity of the symptoms of pituitary basophilism to those of adrenal cortical tumor

* Variations in the clinical pictures which have occurred in association with adrenal cortical tumors bring to mind the variability of clinical pictures in cases of exophthalmic goiter, the term "adrenal virilism" is no more applicable to some cases of adrenal cortical tumor than is the term "exophthalmic goiter" applicable to cases of exophthalmic goiter in which neither goiter nor exophthalmos is present



FIG 3.—(Case 5) (*a*) Appearance of patient's face before (above), and one month after (below) operation (*b*) Full view of patient (*c*) Tumor of right adrenal gland which was removed

The diagnostic problem in dealing with children is somewhat different in character, owing to the fact that pituitary basophilism is predominantly a disease of young women and rarely occurs among children Wright[7] observed a patient, age 11, who is, to our knowledge, the youngest on record to have had this disease Pituitary basophilism is a slowly progressive disease, characterized by plethoric obesity which is confined to the face, neck, chest, and abdomen, hirsutism of the masculine type, amenorrhea, purpuric ecchymoses, hypertension, osteoporosis, varying degrees of diabetes and a number of other variable incidental signs and symptoms In general, the clinical picture is fairly constant, most of the cardinal signs and symptoms described by Cushing are present with the result that most patients who have the disease look very much alike On the contrary, the clinical picture associated with adrenal cortical tumor is much more variable and the disease usually progresses more rapidly Among patients who have adrenal cortical tumors the endocrine symptoms may be, as previously mentioned, minimal or even absent This represents one end of a comparative scale throughout which differing gradations in degree of endocrine disturbance are observed The other end of the scale is represented by the complete picture of adrenal virilism In such cases the clitoris is enlarged, the habitus is masculine, interest in the opposite sex ceases and the psychic status tends to become masculine In the latter type, of which the case reported by Lisser is a good example, and especially when the clitoris is enlarged, the gross features of the malady bear only a superficial resemblance to Cushing's disease However, in the occasional case in which symptoms of the adrenal cortical syndrome mimic in detail all essential features of Cushing's disease, it is exceedingly difficult and often impossible to make a differential diagnosis Consequently, every patient thought to have Cushing's disease, regardless of how typical the condition may seem, should be examined with the suspicion that the disease may originate in the adrenal glands

Laboratory Aids—Routine laboratory studies have been of little aid to differential diagnosis Frank[8] has recently reported a very high concentration of estrogenic substance, equal only to that encountered in pregnancy, in the urine from four patients who had adrenal cortical carcinomata Negative reactions were encountered in specimens of urine from 15 patients who had some symptoms of pituitary basophilism or who had the adrenal cortical syndrome In this group of 15 patients one had a hypernephroma, one had an adrenal medullary paraganglioma, one had an adrenal cortical adenoma, and one had adrenal hyperplasia Frank concluded that "it seems likely that adrenal cortical carcinoma alone of adrenal tumors increases the amount of estrogenic substance in the urine to as high as from 1,000 to 10,000 mouse units per liter, with a negative pregnancy test" In two cases of our series this test gave negative results It would appear, therefore, that a positive Frank test would strongly favor a diagnosis of adrenal cortical carcinoma, but that surgical exploration should not be deferred because of absence of large amounts of estrogenic substance in the urine

Cahill and his associates[9] have recently emphasized a diagnostic procedure, introduced by Carelli,[10] by which the adrenal glands are delineated in

roentgenograms by injection of air into the perirenal fascial space Our experience with this procedure has been very limited and we are not in a position to pass judgment on its merits or its limitations In some of the cases reported in the literature satisfactory visualization of adrenal tumor was obtained when pyelograms were normal It is interesting to note that in the case reported by Lukens and others, "the residual emphysema from the air injection was an added source of difficulty," during operation

We feel that in case of doubt the adrenal glands should be explored surgically, provided the clinician is familiar with the early symptoms of acute adrenal insufficiency, and if adequate facilities are at hand for treatment of this emergency should it arise There are two objections to this viewpoint First, an appreciable number of patients will be disappointed because no benefit results from the operation, and second, it has been stated that in cases in which advanced symptoms of basophilism are present there is considerable



FIG 4.—(Case 6) (*a*) Appearance of face prior to operation (*b*) Appearance of face five months after operation (*c*) Appearance of face three years and ten months after operation

danger of infection In our experience this has not interfered with postoperative progress of patients whose adrenal glands were explored without finding cortical tumors, two of these patients were proved to have Cushing's disease by examination at necropsy months after their dismissal from observation Certainly there is very little justification for the death of patients who receive roentgenotherapy of the pituitary body when the lesion responsible for their symptoms is an adrenal cortical tumor, which might have been eradicated successfully had the patient been operated upon early in the course of the disease

Surgical Mortality Rate.—Until comparatively recently, the mortality rate following removal of adrenal cortical tumor has been almost prohibitive Lukens and his associates found that "of forty cases of all tumor types operated upon, nineteen died, although the recent mortality is less than this" The mortality rate in the cases reported is practically 50 per cent, and the chances are that the actual mortality rate is considerably higher because of the natural tendency in isolated instances to report the successes and not the failures To date eight patients who had adrenal cortical tumors have been operated upon

at the clinic Except for the first patient in the series, who was operated upon in 1924, before the development of efficient methods of controlling adrenal insufficiency, there have been no operative deaths As previously stated, two of the patients ultimately died at home, several months after operation, as the result of metastasis The following factors seem to be responsible for this marked reduction in mortality rate (1) An increased understanding of the disturbed physiology which follows removal of almost all hyperfunctioning tumors of the endocrine system, (2) an increased knowledge of the pathologic physiology of Addison's disease and, as a consequence, improved methods of treating acute adrenal insufficiency

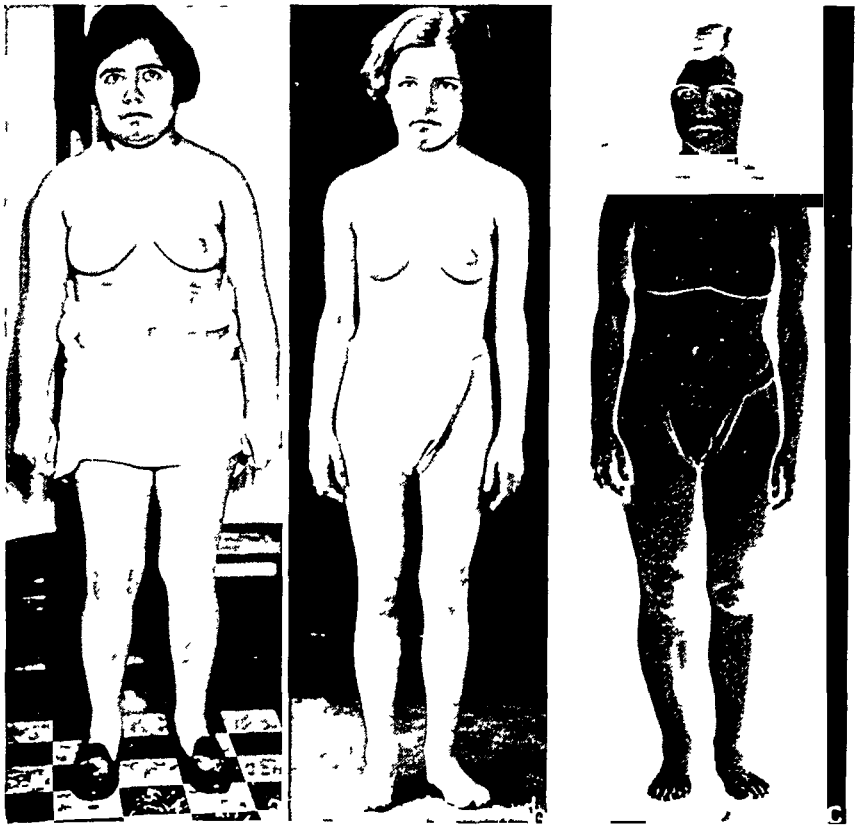


FIG 5.—(Case 6) (*a*) Habitus of patient before operation (*b*) Habitus of patient five months after operation (*c*) Habitus of patient three years and ten months after operation

Dr H S Plummer was, we believe, one of the first clinicians to call attention to the fact that in cases of single hyperfunctioning adenomata of the thyroid gland, the gland proper, as distinct from the adenoma, functioned very little, or not at all In other words, he thought that as function of the tumor gradually increased, irrespective of requirements of the body for thyroxin, function of the gland proper, being under the control of the normal regulating mechanism which determined the output of thyroxin, gradually decreased The same principle seems to apply similarly to hyperfunctioning tumors of other ductless glands In the case of tumors of the adrenal cortex, this principle is illustrated by the fact that the remaining normal gland is

frequently atrophic or is reduced to a vestigial remnant Consequently, after removal of such a tumor the remaining gland, which is either atrophic or, at least, functionally inactive, suddenly has thrust upon it the necessity of making sufficient cortical hormone to maintain life * Not infrequently, this sudden burden proves too great, with the consequence that death occurs after operation owing to acute adrenal insufficiency If the patient could be carried over the immediate postoperative period, eventually the remaining atrophic adrenal tissue would undergo sufficient hypertrophy to compensate for the loss of its fellow, as it does in experimental studies following removal of five-sixths of all adrenal tissue We have reasons to believe that such compensatory hypertrophy occurred in at least three patients In one instance the evidence was unequivocal

The weight of evidence at present favors the view that the fundamental disturbance in adrenal cortical insufficiency centers around the metabolism of sodium and potassium This metabolic disturbance is manifested in the plasma by a reduced concentration of sodium and chloride ions and an increased concentration of potassium ions The other abnormalities in the blood, such as hemoconcentration, retention of nitrogenous products, hypoglycemia *etc* are probably secondary phenomena All these changes can be rectified by administration of cortical hormone and properly balanced mixtures of sodium salts, chiefly sodium chloride, to which has been added sodium in the form of sodium citrate or sodium bicarbonate Furthermore, it has been shown that potassium salts are tolerated poorly in cases of adrenal insufficiency, and conversely, that restriction of foods rich in potassium greatly facilitates treatment

Preoperative and Postoperative Treatment—With these general principles in mind, the preoperative and postoperative treatment of adrenal cortical tumors is obvious In brief, postoperative adrenal insufficiency should be anticipated and should be prevented from occurring by continuous treatment throughout the postoperative period, during which time the patient should be watched carefully for any premonitory signs of acute adrenal failure Among the more important of these signs are anorexia, hiccough, nausea, vomiting, weakness, insomnia, apathy or restlessness, an increasing pulse rate and a falling blood pressure Pyrexia accelerates the development of adrenal insufficiency and is therefore poorly tolerated These clinical manifestations may precede any material change in the chemical composition of the blood The blood pressure should be recorded every four hours and analyses of the blood for its content of sugar, chlorides, and urea should be made daily If, at any time, the condition of the patient is the least suggestive of adrenal insufficiency, more vigorous treatment is instituted or treatment is resumed if it has been discontinued It is not generally appreciated

* Analogous phenomena occur following removal of parathyroid tumors and tumors of the islands of Langerhans In such cases tetany or diabetes may occur postoperatively and subsequently disappear spontaneously Furthermore, Ingle and Kendall[11] have recently produced experimental atrophy of the adrenal cortex in rats by giving large amounts of the adrenal cortical hormone

that fatal adrenal failure can develop within a few hours In consequence of this fact it is easy for the physician to be lulled into a false sense of security A good rule of thumb to remember is that danger lies in undertreatment rather than in overtreatment

Abundant administration of solutions of sodium chloride and sodium citrate and daily intravenous and intramuscular injections of cortical hormone are imperative As soon as a patient is able to retain fluids the salt and ci-



FIG 6 —(Case 7) (*a*) Appearance of patient prior to operation (*b*) Appearance of genitalia note the enlargement of clitoris and precocious growth of hair on labia (*c*) Tumor of left adrenal

trate solution is given by mouth and a diet is prescribed which is low in potassium content The efficacy of this treatment is attested by the fact that since its institution there have been no operative fatalities in seven consecutive cases in spite of the fact that in two instances the adrenal tissue of the opposite gland was found to be atrophic at the time of operation

Surgical Approach to the Adrenals —Although transthoracic, transpleural and retroperitoneal approaches to the adrenal gland have been carried out, in our opinion, the approach which gives the best opportunity for minute and

careful inspection of the gland is through a posterolumbar incision similar to that used in exposing the kidney After the fascia of Gerota has been incised the perirenal fat is reflected from the upper pole of the kidney and the kidney is retracted downward, this exposes the posterior aspect of the adrenal gland It is possible in this fashion to study it accurately from every side without disturbing the circulation, care is taken to prevent injury to the blood vessels which enter the adrenal gland on its mesial and inferior aspect Although we have seen one case of small multiple adenomata, minute in size, in other cases adenomata have been recognized grossly with ease, these have varied in size from 2 to 15 cm in diameter When larger tumors are present practically the entire adrenal gland is thinned out and destroyed, with the exception of a fringe a few millimeters in length, which can be recognized by its brilliant yellow color as being adrenal cortical tissue It must be remembered that on the right side the adrenal gland will be found to be in direct contact with the inferior vena cava Usually the blood vessels supplying an adrenal tumor are much larger than the blood vessels which supply the normal gland On this account care must be taken to ligate them accurately

Report of Cases

Case 1 *—(*Carcinoma of right adrenal cortex. Amenorrhea, lumbar pain, and absence of the other usual endocrine symptoms*) A married woman, age 33, had had amenorrhea for 18 months, in addition, she had recurring attacks of pain in the right upper abdominal quadrant with chills and fever Virilism, hirsutism, and paroxysmal hypertension were not present (Fig 1*a*) On September 26, 1932, a primary adenocarcinoma involving the right adrenal gland (10×8×4 cm) was removed (Fig 1*b*) It had a definite capsule Subsequent to operation the patient was given a course of roentgenotherapy Three months after operation she had gained 20 pounds (9.0 Kg) and had had two normal menstrual periods

The patient returned to the clinic August 13 1936, for reexamination She said that she had felt very well since the operation but that while her periods were regular they were associated with dysmenorrhea and vomiting She tired rather easily Examination revealed no evidence of local recurrence of the tumor or distant metastasis

The patient later reported by letter, November 11, 1937, that she was in good health and her menstrual cycle was normal with the exception of dysmenorrhea She had had no abdominal pain and was maintaining her weight

Case 2 †*—(Penetrating carcinoma of right adrenal cortex, classic symptoms relieved by removal of the carcinoma, recurrence of endocrine symptoms following recurrence of the tumor*) A married woman, age 25, came to the clinic in August, 1933, because of hirsutism, a gain in weight, acne, weakness, amenorrhea, thirst and polyuria of about three months' duration (The gain in weight had been of about one year's duration) She had been examined for life insurance and accepted in December, 1932 Examination revealed that the obesity had largely affected the face, neck and trunk, having spared the extremities Acne, purplish striae, hirsutism, hypertension (180/120), and slight osteoporosis were noted There was pyelographic evidence suggesting a right adrenal tumor At operation, September 12, 1933, a friable adrenal cortical tumor (10×12 cm) was removed with the exception of a few fragments adherent to the vena cava and to the diaphragm Pathologic examination showed it to be an adenocarcinoma arising from the right adrenal cortex

* This case was reported in abstract in the *Proc Staff Meet Mayo Clinic*, 8, 97–110, February 15, 1933

† Early Reports of this case were published in the *Proc Staff Meet Mayo Clinic* 9, 169–181, March 21, 1934, and in the Annals of Surgery, 100, 670–688, October, 1934

In March, 1934, the patient was reexamined Practically all stigmata of her disease had disappeared except for a slight acne The blood pressure was normal and the menses were regular and normal In May, 1934, the patient again returned to the clinic because all her former symptoms had returned, her menses having ceased in April, 1934 Examination revealed findings almost identical to those noted at the time of the initial examination The blood pressure was 180/120 A large, hard mass was also present in the right portion of the middle zone of the abdomen Death occurred in February, 1935, notwithstanding intensive roentgenotherapy

Case 3 *—(*Encapsulated left adrenal cortical tumor with hirsutism, acne and amenorrhea, cure after three and one-half years following removal of the tumor*) An unmarried woman, age 39, came to the clinic April 19, 1934 In December, 1933, her menses had ceased She had gained 13 pounds (5 9 Kg), and hair had begun to appear on her face, legs and thighs Her face, hands and legs then became swollen and an intense acneform eruption appeared on the face (Fig *2a*) The hair of her scalp began to fall out Her skin became dry and she became weak The course of the illness was at first so rapid that acute nephritis was suspected On examination, a marked, acneform papillary eruption with comedones was noted on the face The patient was not particularly obese Her face appeared swollen Hair was noted on the face, chest, and around the nipples, and on the legs and thighs as well as in the midabdominal region The breasts were underdeveloped, the clitoris normal The blood pressure varied from a systolic of 162 to 170 Mm to a diastolic of 102 to 104 Mm The glucose tolerance curve was suggestive of latent diabetes There was slight osteoporosis of the spine An intravenous urogram disclosed no evidence of an adrenal tumor Operation was performed April 27, 1934, and an encapsulated tumor of the left adrenal gland, measuring 2 7x2x1 5 cm and weighing 5 4 Gm , was removed Microscopic examination revealed an adenocarcinoma of grade 1 (on a basis of 1 to 4)

Following operation the patient appeared to be making an uneventful convalescence and was dismissed from the hospital Three weeks after the operation she complained of weakness, anorexia and vomiting, and shortly thereafter jaundice and enlargement of the liver developed Under treatment the jaundice gradually disappeared and the liver could no longer be felt At the time of the patient's final dismissal, June 27, 1934, her face had largely regained its normal contours, and the comedones had decreased at least one-half in size and number The blood pressure was 130/76 The patient's strength was improving

The patient returned to the clinic for reexamination May 25, 1936, at our request The hirsutism and acne had disappeared and she looked well (Fig *2b*) There was no evidence of adrenal insufficiency, although she complained of persisting weakness Blood pressure 126/86 Five months following operation the patient's menses returned to normal Pelvic examination showed nothing abnormal Except for a slight decrease in the value for hemoglobin, nothing abnormal was found on laboratory examination The patient wrote on November 20, 1937, that her general health was good, although occasionally she felt weak Her menstrual periods were somewhat painful and profuse The eruptions on her face and chest had disappeared, as had likewise the coarse, black hair There was a normal distribution of hair on the arms and legs and the contour of the face was normal

Case 4 †—(*Extensive penetrating carcinoma of the left adrenal gland with invasion of kidney and adjacent structures, recurrence of tumor and death from metastasis 14*

* Early reports of this case were published in the *Proc Staff Meet Mayo Clinic,* 9, 169-181, March 21, 1934, and in the ANNALS OF SURGERY, 100, 670-688, October, 1934

* This case was reported in the *Proc Staff Meet Mayo Clinic,* 9, 400–408, July 3, 1934, and in the ANNALS OF SURGERY, 100, 670–688, October, 1934

† This case was reported by Kepler and Priestley in *Arch f klin Chir* , 5, 540–563, 1935

months after operation) A married woman, age 33, was referred to the clinic November 19, 1934, because of changes in her appearance Seven and one-half years previously she had given birth to one child and had then elected to have no more In August, 1934, hair appeared on her face and chest and the pubic escutcheon became masculine in type, her legs and arms had been hairy for a number of years Simultaneously with the growth of hair, her face became full in contour She gained eight pounds (3 6 Kg) The menstrual periods became somewhat irregular but there was no amenorrhea at any time A reddish rash appeared on the chest

Blood pressure 150/90 Glucose tolerance curve normal The clitoris was slightly enlarged In the left hypochondrium there was a lobulated mass which extended to the level of the umbilicus and halfway over to the midline A diagnosis of left cortical adrenal tumor was made Doctor Priestley operated upon the patient November 28, 1934, and found a large tumor adherent to the upper pole of the left kidney, it was also adherent to the diaphragm and adjacent tissue and so friable that the capsule was broken in removing it The kidney was removed as well Pathologic examination revealed a tumor 15 cm in diameter, which was reported to be a hemorrhagic malignant adenoma

The patient's course subsequent to operation was uneventful She was given a course of postoperative roentgenotherapy over the left renal area and was dismissed December 15, 1934 Evidence of recurrence of the tumor began in the summer of 1935, and progressed slowly until the left lung was almost wholly involved Marked enlargement of the liver was noted The patient died January 4, 1936

Case 5 *—(*Encapsulated right adrenal cortical tumor with typical syndrome, partial atrophy of the left adrenal gland*) The patient, age 19, came to the clinic October 12, 1937, because of amenorrhea, pains in the legs, a change in appearance, and weakness Two years previously she began to have acne This increased in severity (Fig 3*a*) Simultaneously she began to gain weight Fourteen months prior to admission her menstrual periods, which had been normal and regular, suddenly ceased, without hot flushes Simultaneously, or shortly afterward, it was obvious that the face, trunk and abdomen were becoming larger and that the legs and arms were becoming thinner

On examination the patient was found to be 65½ inches (166 cm) in height and weighed 112 pounds (50 6 Kg) Blood pressure 116/92 The habitus was definitely masculine The patient's face was full and round and most of the body appeared florid There was slight obesity of the abdomen The skin was dry and there were many purplish striations of the hips, abdomen and thighs (Fig 3*b*) There were also a few striae on both arms below the shoulders There was definite acne of the face and hirsutism was present Although the clitoris was normal, the mons veneris was unusually prominent Laboratory studies disclosed nothing of consequence No prolan was demonstrable in the urine by the Frank technic Nineteen rat units of estrin were found in a 24 hour specimen of urine A glucose tolerance test was slightly suggestive of a latent diabetes The value for blood sugar was 98 mg per 100 cc before the test, one-half hour later it was 205 mg, two hours later 133 mg, and three hours later 65 mg

At operation, October 26, 1937, the left adrenal gland was exposed and found to be about one-half to two-thirds the normal size, it was rather brownish in appearance and contained islands of yellow adrenal cortical tissue A portion 1 cm in diameter was removed from the lower pole for microscopic examination and was reported normal The incision in the left side was closed and the right adrenal gland was exposed It contained a tumor measuring 6×5×2 5 cm (Fig 3*c*) It was freed from the inferior vena cava, the pedicle ligated and the tumor removed Both incisions were closed without drainage On pathologic examination the tumor was found to weigh 50 Gm, and was reported to be a cortico-adrenal cytoma (relatively benign)

*Kepler, E J, Walters, Waltman, and Piper, M C Tumors of the Adrenal Cortex Diagnosis and Treatment Case Report *Proc Staff Meet Mayo Clinic* (In press)

The patient's postoperative course was complicated by an increase in temperature and pulse rate Twenty cubic centimeters of cortin and saline solutions were administered daily The patient left the hospital November 15 At the time of discharge the high color of the face and extremities was reduced at least 75 per cent The face was assuming its normal contour and the striations were fading The excess hair on the face and extremities had not changed materially The patient wrote on December 28, 1937, that she had begun to menstruate December 27, 1937, and that she was feeling very well Acneform eruptions were beginning to fade and the hair on her face to disappear

Case 6 *—(*Encapsulated left adrenal cortical tumor, partial atrophy of right adrenal, premature menstruation and other typical symptoms No recurrence of symptoms after four years*) The importance of this case and the excellent result which has been maintained over a period of four years without evidence of recurrence make it worthy of describing again The patient, a girl, age 9, was referred to the clinic in September, 1933 There was nothing significant in the family history Birth and development had been normal, she had been healthy until the onset of the difficulty for which she was brought to the clinic When she was four years of age, her mother had observed the unusual development of her breasts, a generalized growth of hair over her body, and deepening and coarsening of her voice A year later the pubic hair had become abundant and the external genitalia had developed abnormally At eight years of age the child had menstruated for four days, and afterward there had been some menstrual spotting at intervals of about two months The mentality and personality had undergone no great changes, but the child seemed to spend most of her time at home and to shun the company of other children In her selection of companions she showed no preference for members of either sex She was in the fifth grade at school and was doing well with her lessons

On examination the most striking features were (1) Obesity affecting the trunk, neck and face (Fig 4*a*), (2) hypertrichosis of the face and body, especially prominent in the axillae and on the mons veneris, (3) purplish, atrophic striations over the abdomen, thighs, and buttocks, (4) precocious development of the breasts and external genitalia, (5) acne of the face and trunk (Fig 5*a*), (6) a slight elevation of the blood pressure (133/97), and (7) a bone age of 12 years The outlines of the kidneys in the intravenous urogram were normal

Surgical exploration was performed October 31, 1933 The right adrenal gland was about one-half the usual size A section removed for microscopic examination was normal histologically The position of the left adrenal gland was occupied by a large, encapsulated tumor measuring 6×4×2 cm, a portion of which projected into an enlarged adrenal vein The tumor was completely removed and was found to be a cortical carcinoma In three weeks the weight had fallen and the excessive hair was beginning to disappear Later, the menses ceased, the skin became smooth, the voice became pitched higher, the breasts and external genitalia became smaller, and the other symptoms and signs of the disease gradually disappeared (Figs 4*b* and 5*b*)

The patient returned at our request for reexamination July 27, 1937 She stated that she had been perfectly well since her last visit in March, 1934 She was then 13 years of age and was to enter high school that fall She was doing well in school, and taking piano lessons and was reasonably active Her menses reappeared 22 months after operation and have been regular and normal ever since Examination July 27, revealed her to be a normal adolescent girl (Figs 4*c* and 5*c*) with the exception that her breasts were rather large, and contained a considerable amount of adipose tissue The genitalia were normal but of the adult type The clitoris had receded in size, and while large, was not huge The striae in the thighs had bleached out, and the hirsutism and acne had not reappeared Blood pressure 110/72

* This case was reported in the *Proc Staff Meet Mayo Clinic*, 9, 169–181, March 21, 1934, and in the ANNALS OF SURGERY, 4, 678–682, October, 1934

Case 7 *—(*Encapsulated left adrenal cortical tumor with somatic and sexual precocity and menstrual bleeding*) A girl, age 23 months, was referred to the clinic by Dr R K Dixon of Denver, Colorado, who had made a diagnosis of probable adrenal cortical tumor She had been delivered at full term by cesarean section Her mother said that she had always seemed to be somewhat mentally precocious At 18 months she had begun to show precocious physical development She fed herself, went to bed alone and acted like a child of four or five years At the same time it was noted that the labia and clitoris were becoming larger and that black hair was appearing on the labia majora The child began to grow rapidly, her shoulders broadened, and she increased in height At 23 months she was able to exchange dresses with her sister then age five years, although the sister's clothes had to be shortened somewhat It was then noted that the patient's hands were about as large as her sister's On December 12, 1936, there was marked vaginal bleeding, lasting one day The patient was then 19 months old For six weeks prior to admission a little acne had been noted on the forehead, and a few weeks prior to admission the child had developed a sense of modesty and had objected to being nude at home or in the examining room and insisted on going to the bathroom alone

On examination the child was found to be 37 inches (94 cm) in height and weighed 30 pounds (13.6 Kg) She appeared definitely larger and heavier than a normal girl of her age (Fig 6*a*) Blood pressure 116/70 The labia majora and minora were well developed Hair was present on the labia and there was a definite disproportionate enlargement of the clitoris (Fig 6*b*) There were no laboratory findings of significance except that roentgenograms of the extremities showed the bone age to be approximately five years There was no sugar in the urine The urine was assayed for prolan and estrin, with entirely negative results A portion of the adrenal cortical tumor was extracted for estrogenic substances but none was found

On March 23, 1937, a tumor weighing 45 Gm and measuring 5.5×4.5×4 cm was removed from the left adrenal gland (Fig 6*c*) The postoperative convalescence was uneventful and the patient left the hospital on the tenth day postoperative

On July 13, 1937, she was reexamined by Doctor Dixon and found to be in excellent condition She then weighed 30 pounds and was 38 inches in height The pubic hair had changed very little There had been no further suggestion of menstrual bleeding It was observed that the child did not eat as heartily as she had before operation

SUMMARY —Seven consecutive cases of adrenal cortical tumor, in which recovery has occurred following removal of the tumor, are analyzed as a basis for discussing problems associated with this lesion Symptoms produced by a tumor of the adrenal cortex depend on the sex and age of the patient at the time the tumor begins to function These tumors are encountered most frequently among women and are characterized by variable changes in secondary sexual characteristics, such as cessation of menstruation, occasionally hypertrophy of the clitoris, abnormal growth of hair with masculine distribution and characteristic lesions of the skin such as a florid complexion accompanied by acne and purplish striations Among girls, tumors of the adrenal cortex tend to produce precocious puberty, more masculine than feminine in character The disease seldom occurs among males, either young or old The difficulty in making a diagnosis arises from the fact that the clinical picture is not pathognomonic Similar clinical pictures may result from any

*Kepler, I J, Walters, Waltman, and Dixon, R K Menstruation in a Child Nineteen Months Old Result of a Tumor of the Left Adrenal Cortex Successful Surgical Treatment *Proc Staff Meet Mayo Clinic* (In press)

one of a number of diversified pathologic processes, such as Hyperplasia of the adrenal cortices with or without thymic tumors with tumors of the gonads, and various intracranial lesions not directly involving the pituitary body

Routine laboratory studies have been of little aid in differential diagnosis although the presence of a high content of estrogenic substance in the urine is suggestive of the presence of adrenal cortical carcinoma provided pregnancy is excluded Injection of air about the adrenal gland has been of aid in localizing some of the adrenal tumors In 40 cases reported in the literature the surgical mortality rate was approximately 50 per cent It is our opinion that the absence of mortality in seven consecutive cases in which operation was performed at the Mayo Clinic is attributable to an increased understanding of the disturbance of physiologic processes which follows removal of almost all hyperfunctioning tumors of the endocrine system, and to an increased knowledge of the pathologic physiology of Addison's disease, improved methods of treating acute adrenal insufficiency have thereby been developed These consist primarily of administration of large quantities of sodium chloride and sodium citrate, daily administration of an adequate amount of cortical hormone, and a low potassium diet, throughout the entire postoperative period In our experience, the most accurate surgical approach to the adrenal glands has been through retroperitoneal and posterolumbar incisions

REFERENCES

[1] Lisser, H A Case of Adrenal Cortical Tumor in an Adult Male Causing Gynecomastia and Lactation Endocrinology, 20, 567–569, July, 1936

[2] Mainzer, F Nebennierenrindensyndrom mit arterieller Hypertension Acta med Scandinav, 87, 50–64, 1935

[3] Guthrie, Leonard, and Emery, W d'E Precocious Obesity, Premature Sexual and Physical Development, and Hirsuties in Relation to Hypernephroma and Other Morbid Conditions Tr Clin Soc London, 40, 175–202, 1907

[4] Josephson, Bertil The Adrenal Cortical Syndrome in a Case with Tumor from an Accessory Adrenal Gland Acta med Scandinav, 90, 385–396, 1936

[5] McQuarrie, Irvine, Johnson, R M, and Ziegler, M R Plasma Electrolyte Disturbance in Patient with Hypercortico-adrenal Syndrome Contrasted with That Found in Addison's Disease Endocrinology, 21, 762–772, November, 1937

[6] Lukens, F D W, Flippin, H F, and Thigpen, F M Adrenal Cortical Adenoma with Absence of the Opposite Adrenal, Report of Case with Operation and Autopsy Am Jour Med Sci, 193, 812–820, June, 1937

[7] Wright, C A Pituitary Basophilism, a Discussion of Additional Factors in Relation to Four Cases Med Rec, 141, 191–196, February 20, 1935

[8] Frank, R T A Suggested Test for Cortical Adrenal Carcinoma JAMA, 109, 1121, October 2, 1937

[9] Cahill, G F, Loeb, R F, Kurzrok, R, Stout, A P, and Smith, F M Adrenal Cortical Tumors Surg, Gynec & Obstet, 62, 287–313, February, 1936

[10] Carelli, M H H Sur le pneumoperitoine et sur une methode personnelle pour voir rein sans pneumoperitoine Bull et mem Soc med d hop d Par, 2, 1409–1412, October 28, 1921

[11] Ingle, D J, and Kendall, E C Atrophy of the Adrenal Cortex of the Rat Produced by the Administration of Large Amounts of Cortin Science, 86, 245, September 10, 1937

DISCUSSION —DR MIMS GAGE (New Orleans, La)—I wish to congratulate Doctor Walters for presenting this interesting subject, and giving us a method by which we can differentiate the basophilic tumors of the pituitary from the cortical tumors of the adrenal However, this differentiation becomes increasingly difficult when one is confronted with the arrhenoblastoma occurring in the female As Doctor Walters has stated, every method of precision, both biochemical and physical, should be exhausted before one confirms a tentative diagnosis At times exploration becomes absolutely necessary in order to settle the confused picture

In order to prevent the occurrence of fatalities following the removal of cortical tumors of the adrenal gland we should employ the methods of preoperative preparation and postoperative treatment as outlined by Doctor Walters Failure to supply one of our cases with cortical hormone immediately after operation resulted in a fatality This patient developed marked hypo-adrenalism before the hormone therapy was instituted I believe the fatality could have been prevented if the hormone had been given immediately after operation as suggested by Doctor Walters

DR LOYAL DAVIS (Chicago, Ill) —I should like to ask Doctor Walters to emphasize once again the differentiation between the cases which he has presented and those suprarenal tumors which are associated with paroxysmal hypertension We have recently seen a patient with the latter condition but unfortunately we did not have the opportunity to verify it either at operation or at autopsy

I should like to bring up another point which is in relation to the symptoms of sexual hypertrophy which Doctor Walters found in his one young male patient, in which he felt there was some disturbance in the region of the pineal gland Recently we have been able to remove the pineal gland experimentally in kittens, six weeks old, by the use of the Horsley-Clarke stereotaxic instrument With this instrument any desired point within the brain or brain stem of an animal may be reached and the lesion may be produced by electrolysis Such animals, without the pineal gland, and this applies particularly to the males, show a very rapid onset of maturity There are an increase in their weight and a change in their physical appearance as well as in their external genitalia As far as we know this is the first time that such definite changes have been produced in animals this high in the mammalian scale

DR ERNEST SACHS (St Louis, Mo) —I would like to record a case bearing on the point that Doctor Davis has just brought up, namely, intermittent hypertension We had a patient with a diagnosis of a suprarenal tumor, but she had none of the other characteristics of these cases as shown by Doctor Walters She did have a choked disk, and finally we were able to remove a tumor from the occipital lobe, after which the hypertension diminished It has been pointed out before that tumors far back in the hemisphere do have hypertension associated with them, and that is another thing that may have to be considered in some of these cases

DR WALTMAN WALTERS (closing) —I was very glad to have Doctors Gage and Davis, and Doctor Sachs discuss my paper, because the relationship of intracranial lesions to this syndrome is, I think, one of the very difficult things we have to eliminate It is easy to explore the suprarenal glands, and it can be done with safety, but, on the other hand, the relationship of intra-

cranial lesions to the syndrome is still obscure Doctor Davis' interesting experiments should help to clarify some of these problems

Both Doctor Davis and Doctor Sachs have referred to cases of suprarenal tumors in which paroxysmal hypertension was present Suprarenal tumors producing paroxysmal hypertension take their origin from the medullary portion of the gland, which embryologically is derived from the same structures as the sympathetic nervous system This probably accounts for the predominant symptom of paroxysmal hypertension in these cases, in contrast to the symptoms of precocious puberty, virilism, *etc*, associated with the tumors of the suprarenal cortex, the cortex embryologically taking its origin from tissue giving rise not only to the suprarenal cortex but to the testes and ovaries

Doctor Toland has asked me to what one can attribute the great decrease in the mortality rate following operations for tumors of the suprarenal cortex The explanation for this, I think, is largely that we have extracts of the suprarenal cortex which can be administered to the patients both prior to and subsequent to operation, and recognition that certain electrolytes, such as sodium, are lacking in patients who have insufficiency of the suprarenal cortex The importance, therefore, of seeing that an abundant amount of sodium is administered, both as sodium chloride and sodium citrate, to these patients, has been emphasized in our paper Of particular importance is the necessity of keeping the patient from whom a suprarenal cortical tumor has been removed under the closest supervision not only during the first few hours after operation but every hour until his complete recovery It is not generally understood that insufficiency of the suprarenal cortex may occur within eight hours, and may at first be so mild in its clinical characteristics that it may escape detection until a true insufficiency of the suprarenal cortex is present When such occurs, the "set-up" is not unlike that of the so-called irreversible reaction in cases of diabetic coma, in which, although the acidosis and the hypoglycemia are adequately controlled, the patients continue on to their demise That these factors are important is evidenced by the progress of the last patient I operated upon, a woman, age 19 We first explored her left suprarenal gland and found it to be only about one-half to two-thirds the normal size There was so little yellow cortical tissue present that the gland was a brown, mottled yellow as a result of islands of cortical tissue The tumor on the right side, which measured 6x5x2 5 cm, involved the entire gland After the removal of the tumor it was apparent that there was marked atrophy of the left suprarenal gland and marked diminution in the substance of the suprarenal cortex Vigorous treatment with extract of the suprarenal cortex and a solution of sodium administered intravenously as well as sodium citrate administered by mouth prevented any evidence of insufficiency of the suprarenal cortex Of almost equal importance is the necessity of a low dietary intake of potassium, in the prevention of acute adrenal insufficiency

THE SURGICAL PROBLEM OF HYPERTENSION

LOYAL DAVIS, M D , AND M HERBERT BARKER, M D
CHICAGO, ILL

FROM THE DIVISIONS OF SURGERY AND MEDICINE NORTHWESTERN UNIVERSITY MEDICAL SCHOOL CHICAGO, ILL

BASED upon the assumption that removal of the sympathetic supply in cases of Raynaud's disease results in a permanent dilatation of the blood vessels of an extremity, Rowntree and Adson[1] applied the same surgical principle to the treatment of patients with essential hypertension

Lack of complete knowledge of anatomic and physiologic facts concerning the sympathetic nervous system makes it difficult to evaluate the results of surgical intervention In several instances in the past, the indiscriminate clinical employment of operations upon the sympathetic nervous system has eventually proven to have been a mistake, and has retarded the acceptance of other procedures logical in their conception and successful in their application

There can be no doubt that any surgical procedure which offers relief to patients with essential hypertension, for many of whom medical treatment admittedly offers no hope, is welcome But, when evaluating that surgical procedure all of the severe criteria applied to an experimental physiologic investigation must be employed

The first problem is to define "essential hypertension," a term which betrays a general ignorance concerning the clinical syndrome to which it is applied

According to our own views, essential hypertension is a disorder with one or more etiologic factors, in which the blood pressure is over 160 Mm systolic and 90 Mm diastolic, with exacerbations and remissions which ultimately result in pathologic changes in one or more parts of the cardiovascular-renal system, notably arteriosclerosis, cardiac hypertrophy, nephrosclerosis and ocular vessel disease The degree and speed of the development of these changes depend somewhat upon the age of the patient and the height of the blood pressure, the younger the patient and the higher the blood pressure, the more rapidly progressive is the associated vascular disease

Experimentally, hypertension has been produced in four ways

(1) Heymans[2] and his coworkers have produced a rapid and permanent rise in blood pressure by removal of the carotid sinus and the cardio-aortic moderator nerves This type of hypertension may be prevented or decreased only by a complete sympathectomy, section of the splanchnic nerves, lumbar ganglionated chain or adrenalectomy have only a transient effect This experimental type of hypertension may be similar to the few clinical cases observed with extremely labile blood pressures, but does not correspond with the more common type of clinical hypertension

(2) Goldblatt[3] has recently succeeded in producing several grades of hypertension lasting months and years by reducing the caliber of the main renal arteries by the application of an adjustable silver clamp The resultant renal ischemia due to persistent reduction of blood flow in the kidneys has been uniformly successful in establishing an experimental hypertensive state

Goldblatt has shown that after the development of hypertension by this method, release or removal of the clamps is followed after a variable period by return of the blood pressure to the original level Unilateral application of the clamp is followed by elevation of blood pressure over a considerable interval, but if the clamped kidney is removed the blood pressure returns to normal Clamping the artery of the remaining single kidney will again elevate the blood pressure The complete occlusion of both renal arteries is followed by a severe uremia, but by only a moderate elevation of blood pressure Denervation of the renal pedicles does not interfere with the development of experimental hypertension produced in this manner and Goldblatt has shown, further, that section of the splanchnic nerves above the diaphragm, combined with excision of the lower four thoracic sympathetic ganglia, does not materially reduce the systolic blood pressure Likewise, he has shown that section of the anterior roots from the sixth dorsal to the second lumbar, inclusive, does not interfere with the development of, nor does it permanently reduce hypertension produced in this manner by renal ischemia To complete the investigation, Freeman and Page[4] have shown that total sympathectomy does not interfere with experimental hypertension produced by renal ischemia—an important difference between this and the type of hypertension experimentally produced by Heymans

But Goldblatt has also shown that if the adrenal veins are clamped simultaneously with partial occlusion of the renal arteries, hypertension does not develop Further, hypertension develops if only a small portion of the adrenal cortex is left, sufficient to keep the animal alive

It is suggested, therefore, that in hypertension due to renal ischemia, an "effective substance" is formed in the ischemic kidney As Goldblatt states, this renal substance may not act directly by itself but may sensitize the contractile elements of arterioles to the action of a pressor hormone generated elsewhere Or, it may sensitize other organs so that the natural metabolic processes such as occur in the liver, for example, are interfered with That the hypophysis must be given some consideration in this mechanism is attested by the experiments of Page[5] who has shown that hypophysectomy does not prevent the experimental hypertension due to renal ischemia but that it does reduce permanently the blood pressure in animals with this type of hypertension

These experiments have been amply corroborated and Harrison, Blalock and Mason,[6] and Prinzmetal and Friedman[7] have presented evidence to show that extracts of ischemic kidneys contain a greater amount of pressor substances than normal kidneys but whether these substances are the cause of this type of experimental hypertension is not known

(3) Experimental hypertension can be produced by ligation of the carotid, vertebral and spinal arteries The resulting cerebral ischemia produces a permanent rise in blood pressure, due probably to anoxemia of the vasopressor centers

(4) Finally, it has been shown that the administration of vitamin D results in elevation of the blood pressure In rabbits, an arteriosclerosis is produced which can be duplicated in dogs by performing a thyroidectomy and feeding vitamin D

Which of these experimental types of hypertension are analogous with essential hypertension in man? Or, are all of these factors involved in a given case? The failure of response to the "carotid sinus" type of hypertension to any operation except total sympathectomy and the failure of the "renal ischemic" type to respond to total sympathectomy must be rationalized Thus far, the interpretation of these experiments seems to show that removal of the vasoconstrictor sympathetic supply to the vessels of the splanchnic area, theoretically producing a reservoir of dilated vessels, does not prevent or reduce the "renal ischemic" type of experimental hypertension In other words, the important factor concerns the reduction of blood flow to a functioning kidney and not the general vasomotor mechanism of the abdominal viscera

As is often the case, these results cannot be transferred directly to the problem of hypertension in man because in a great many cases there is no narrowing of the larger vessels due to arteriosclerosis which would so effectively narrow the lumen of the renal arteries But one of the constant pathologic findings in essential hypertension is a narrowing of the arterioles of the kidney Thus, it is conceivable that an improvement of the circulation of the functioning parts of the kidney by dilating the arterioles might result from removal of the vasoconstrictor mechanism

Clinically, the criteria for classifying patients as cases of essential hypertension vary considerably among various groups of workers Yet, before surgical procedures can be evaluated, agreement must be reached as to exactly which type of patient is being operated upon, or should be operated upon Not all will agree with the statement of one group that 85 per cent of all patients with a high systolic blood pressure belong to the primary, or essential, type of hypertension for which no etiologic factor can be found Again, should the patient with a tumor of the adrenal gland, with a basophilic adenoma of the hypophysis, with chronic glomerular nephritis, with a carotid sinus disorder, or with hyperthyroidism be admitted to this group by reason of a high blood pressure?

There is agreement that the clinical course of a young adult with essential hypertension may be an intense progression to a fatal termination within two years, that is, uremia and death cannot be stayed by medical treatment On the other hand, a variable hypertension of mild degree may exist in adults under 35 years of age, which represents vasomotor instability and either requires no treatment, or is controlled by simple medical measures Late in life, a high systolic blood pressure with a normal, or nearly normal diastolic pressure,

related to sclerosis of the large vessels of the body, is relatively unimportant and does not require treatment

It is agreed, also, that about 90 per cent of the mild cases of hypertension at all ages either have no symptoms or are easily relieved Of the cases of moderately increased blood pressure, 75 per cent either have no symptoms or can be relieved Of the severe group over 45 years of age, many have reached a late stage in the disease after a long course Under medical treatment, at least 30 per cent of these patients may obtain a substantial fall in their blood pressure and another 40 per cent may obtain symptomatic relief over long periods of time The remaining 30 per cent in this group have marked and irreversible vascular changes, which make amelioration of their symptoms impossible We are confronted, then, with the group of young adults with malignant progression of their symptoms of hypertension and those patients with a moderate hypertension under 45 years of age for whom surgical intervention may hold hope

Our experience has not given us a clear picture of differentiation between the "essential" and the so-called "malignant" phases of the disease To us, malignant hypertension is denoted by that fulminating endothelial necrotic state which may develop at any time in any hypertensive patient, which usually rushes him through to an early death with evidences of widespread destruction of the vessels in the kidneys, retinae and brain We have seen such changes come on suddenly in patients with severe essential hypertension resulting in terrific headaches, stupor, motor phenomena, cardiac gallop-rhythm, hemorrhages from the nose and urinary tract and actual rupture of the retinal vessels Such a fulminating episode may be as dramatic as a fatal lobar pneumonia However, some of the malignant cases may go on for months with periods of exacerbation and remission Rarely, such a patient may be much improved for a long time after a coronary occlusion or a cerebral vascular accident We have also seen a reversal from the malignant to the essential type by reducing the blood pressure and controlling it by the administration of cyanates [8] This type of reversal in the phases of the hypertensive state should cause us to consider carefully surgical treatment

At which stage in the disease is surgery contraindicated and what constitutes the basic factors for such contraindications? Is it fair to require that the surgical treatment of essential hypertension be evaluated according to its effectiveness in various types and degrees of severity of the disease and the sole criterion be the effect upon the systolic blood pressure? If so, by what standards can the types and degree of severity of the disease be so classified that the results of surgical therapy in one clinic may be compared with another? We suspect that many of the favorable surgical results reported thus far might be duplicated by another group of workers through medical measures alone However, operations have been performed upon patients who might be considered by other workers as wholly unsuited for surgery Is the systolic blood pressure the most important factor upon which to judge the effect obtained? We admit with others, that the lowering of the diastolic pressure is a far more

significant result relative to the patient's welfare Finally, by what train of physiologic events is the blood pressure reduced following operation?

Several surgical procedures have been proposed for the reduction of hypertension and several tests are now being used to determine if possible which patients may be expected to give a satisfactory result All of these tests and the operative procedures are based on the assumption that the vasoconstrictor innervation and control of the blood vessels of the splanchnic area, or of the kidney alone, can be removed

The surgical procedures employed have been several and varied A bilateral lumbar ganglionectomy and trunk resection proved ineffective because only the vessels of the lower extremities were dilated Section of the anterior roots between the sixth thoracic and second lumbar segments, inclusive, interrupts all of the efferent sympathetic vasoconstrictor fibers to the kidneys, adrenals, and in addition creates a large reservoir of dilated vessels in the splanchnic vascular area, but the magnitude of the operation and the occasional resulting spinal cord lesions have discouraged its use Another surgical procedure is directed to the bilateral supradiaphragmatic section of the splanchnic nerves designed to remove the vasoconstrictor fibers from the renal vessels, but the basis for this operation rests upon electrical stimulation experiments alone Still another operation plans to denervate the adrenal glands and remove the celiac ganglion The technical difficulty of performing this operation accurately is obvious Another operation includes resection of the three splanchnic nerves bilaterally, removal of the first and second lumbar ganglia and removal of one-third to one-half of each adrenal gland Recently, partial removal of the adrenal glands has been discarded as being wholly ineffective

The best results from this last operation were obtained in young adults with hypertension who showed a marked fall in blood pressure after the administration of pentothal, amytal or nitrites In another clinic the specific gravity of the urine and the urea clearance test are the criteria of operability, assuming that the latter test parallels the blood flow in the renal artery However, the urea clearance test has been shown to improve in one patient with a postoperative fall in systolic blood pressure, to remain stationary in a second patient with a comparable fall in pressure, and in a third patient to improve without any fall postoperatively in blood pressure

The results obtained by bilateral supradiaphragmatic removal of the splanchnic nerves in 48 patients has been reported by Freyberg and Peet[9] Six patients showed a blood pressure reduction to 160/100 or less, in eight, the systolic drop never reached 160 but there was a reduction in systolic pressure of more than 60 Mm In ten patients, the systolic reduction was between 30 and 60 Mm , in 23 the pressure was unchanged and in one there was an increase in systolic pressure Recently, Peet[10] reported that of 156 patients operated upon there was an operative mortality of 3 8 per cent, 34 patients had died later of their disease and of 100 patients studied, 48 per cent had a drop of at least 40 Mm in their systolic pressure Page and Heuer,[11] after anterior root section, stated that the renal efficiency, as measured

by urea clearance and the ability to concentrate urine was unchanged either by the partial denervation of the kidneys which resulted from the operation or from the fall in blood pressure

Adson, Craig and Brown[12] have reported 13 good results, six fair, six failures, and two deaths from anterior rhizotomy, two good, one fair, and four failures following splanchnic section with removal of the first lumbar ganglion, and five good and two fair results after splanchnic section, removal of the first and second lumbar ganglion and partial removal of each adrenal gland

The surgical results, thus far obtained, are not conclusive Neither the rationale nor the results of the operations are susceptible to an accurate physiologic explanation

Our own work has been concerned with patients suffering from hypertension, and with the production of experimental hypertension Our report at this time is purely in the nature of a preliminary communication to set forth the approach which we are making to this problem because we are convinced that by so pooling information the accurate solution of the problem at least from the surgical aspect may be arrived at more promptly

Careful clinical studies were made upon the patients we have operated upon and in the majority of instances the patients have been under observation over a long period of time The following criteria are used in choosing patients from the Renal-Vascular Clinic for splanchnicectomy

(1) All patients have a severe grade of essential hypertension Systolic pressures are 200 or over and the diastolic pressures are above 100 Mm of Hg

(2) As far as can be detected by a careful history, physical examination and laboratory data, there is no evidence of chronic glomerular renal disease

(3) There is no evidence of peripheral arterial sclerosis Angina pectoris or evidence of a high degree of spasm in the retinal vessels, or angiospastic renal disease, are not contraindications to operation

(4) Throughout their months or years of observations, blood pressures showed normal fluctuations, that is, their pressures are not frozen at a definite level

(5) All of the patients have been given a thorough trial with potassium sulphocyanate* over a period of several months up to two years Cyanates

* Recently, one of us (M H B) has reported upon the encouraging results of cyanate therapy, with a proper control of the blood cyanate level, in 45 patients with systolic blood pressures well over 200 These patients had been examined regularly and their blood pressures followed through periods of from one to four years on various forms of medical therapy This selection of patients with individual variations, seasonal changes, environmental influence and other factors, enabled him to evaluate the results of therapy Thirty-five patients in the group responded to a blood cyanate level of between 8 and 12 mg per 100 cc of blood by a reduction of the systolic and diastolic blood pressure and relief of their symptoms Although the reason for the failure of ten patients to respond to cyanate therapy is not clear, it was evident that the most resistant cases presented evidence of well-advanced arteriosclerosis It seems fair to point out, therefore, that patients with essential hypertension, regardless of their age, or the severity or stage of the disease, should be given a therapeutic trial with cyanates

are discontinued for one of two reasons, either they show some response to cyanate therapy but the dose necessary to lower their blood pressure is large enough to cause symptoms of cyanate intoxication, or they are not sensitive to cyanates particularly in regard to their diastolic blood pressure

Briefly, then, we choose only relatively young hypertensive patients without renal damage whose blood pressures under normal conditions show rather marked fluctuations, whose vascular tree is still elastic and who, over a long period of time for one of two reasons, have been found to be insensitive to cyanate therapy

The patients are admitted to the hospital for a period of four or more weeks of critical study and blood pressure observations These studies and observations consist of

(1) Renal function tests of concentration and dilution power, urea clearance and fractional phenolsulphonphthalein excretion Blood chemistry studies are made which include total protein, cholesterol, uric acid, blood and fluid volume, as well as glucose and insulin tolerance tests Several check observations are made to insure the control findings Blood pressures are taken morning and evening during bed rest for a period of four days, and continued until it is felt that a normal basal level has been reached Blood pressure charts are kept along with the bedside notes and all pressures are graphed so that the general tendency of the course can be clearly seen

(2) After normal reactions have been studied, the patient is next allowed to become ambulatory and pressures are taken, (a) while ambulatory, (b) after meals, (c) during periods of nervousness or excitement, and (d) while asleep These are considered to be the pressures that might be reached under normal or working conditions during an average 24 hour day

(3) Following this, the cold-pressor test is done according to the method described by Hines and Brown [13]

(4) A nitroglycerine test is also performed (1/400 to 1/100 grain of nitroglycerine under the tongue), and the drop in the pressure is recorded each minute for a 20 minute period, or until the readings show that the pressure has returned to the average normal level

(5) The changes in blood pressure during a period of deep sleep induced by amytal are then followed Similar observations are made while under two types of anesthesia Pentothal of sodium after the method described by Lunde and avertin anesthesia

The above two methods are used as a measure of the patient's lowest probable pressure under artificially controlled conditions Blood pressure readings taken after immersing the patient in a warm tub to promote peripheral vascular dilatation was also tried but the results, so far, have not been well enough studied to permit of further comment

(6) In order to see just how high the blood pressure might be elevated under controlled conditions, the patient is cautiously given inhalations of carbon dioxide A mask is placed on the patient's face, and oxygen is administered long enough for the patient to become accustomed to the mask and to breathe

naturally After a basal level has been reached, the concentration of carbon dioxide is gradually increased to a level of 1, 3, 5, and rarely 7 per cent over a period of five minutes Pressure readings are taken every 45 seconds until the distress of the patient is evidenced by hyperventilation, restlessness or dilatation of the pupils

All symptoms noticed by the patient and all the observations upon the pulse, respiration and peripheral vascular bed are carefully recorded These observations together with the blood fluctuations noted during this group of tests are then analyzed for the discussion of the feasibility of splanchnicectomy

After operation, when the patient has recovered from the procedure and when the blood pressure has once again leveled off, the patient is reexamined by the same tests and all changes (if any) are noted

It has been interesting to note that in patients whose daily fluctuations of pressure occur during periods of excitement, after meals, or following exercise, and whose pressure drops to relatively low levels at bed rest and during sleep, the average work load (systolic and diastolic blood pressure) of the cardiovascular-renal system corresponds almost directly to the high peaks of pressure and the low levels produced by the administration of carbon dioxide and during sleep respectively

With one exception, the patients operated upon have been proven to be resistant to the administration of cyanates That is to say, the blood pressure had not responded to this type of therapy, even when the blood cyanate level had been pushed to the maximum of safety with the patient at complete rest The number of patients operated upon thus far is small, totaling six, because we have restricted our surgical indications to the comparatively small number of patients with essential hypertension who are cyanate resistant

With one exception, each patient had a bilateral supradiaphragmatic section of the splanchnic nerves In this single case, the splanchnic nerves were sectioned below the diaphragm, the lumbar sympathetic ganglia and chain were removed and a portion of each adrenal gland was removed elsewhere But in this case, the patient had been adequately studied preoperatively by us and had proven resistant to cyanates

Since this is in the nature of a preliminary report, we wish to report our results in a general manner, reserving until a later date the presentation of all of the statistical data upon each patient We have observed an immediate fall in blood pressure following operation but in no case has it persisted longer than ten days In each case the systolic and diastolic pressures have been returned to their preoperative levels This has been so even in those cases which showed a drop in blood pressure following the administration of pentothal, amytal or avertin preoperatively The blood chemistry determinations made at frequent intervals following observation have shown no decisive change but the insulin sensitivity test in each instance has given corroborative evidence of the fact that the splanchnic nerves have been sectioned thoroughly

Two patients, including one operated upon by us and the one operated

upon elsewhere, have presented an interesting and, we believe, important response following operation Whereas, in each instance the systolic and diastolic pressures have returned to their preoperative level with the return of all of the distressing symptoms of which the patients complained, and whereas, prior to operation they proved to be cyanate resistant after a long and adequate trial period, following operation, they now respond to the administration of cyanates with disappearance of all of their symptoms and a reduction in their systolic and diastolic pressures In one instance, we are now in the process of allowing the blood to become free of cyanates, in an effort to see if the patient will again return to her previous high level and thus far, there is every indication that this is the case We are, of course, unable to explain as yet the physiologic mechanism of this response in two patients but this constitutes one of the problems, the answer to which we are seeking in the experimental laboratory

We have been able to produce hypertension experimentally in dogs, according to the method of Goldblatt, without the slightest difficulty The most annoying part of the experiment is to be able to obtain blood pressure readings on animals with certainty and accuracy As yet, we have not been able to place dependence upon any of the cuff methods, which have been used by others, nor have we been able to utilize the carotid loop method used to such advantage by Goldblatt We have relied upon a manometric reading obtained by direct puncture of the femoral artery which, of course, provides the mean arterial pressure All of the animals have been of the German shepherd breed and all have been trained to lie down on the table quietly while the blood pressure readings are made Needless to say, readings have been made over a sufficiently long period to establish a normal range for each animal

Our preliminary studies have indicated that experimental hypertension produced by renal ischemia can be reduced by the administration and the reduction of blood pressure as occurs in patients The problem of the physiologic mechanism by which the cyanates reduce blood pressure and the relationship suggested between splanchnicectomy and the administration of cyanates, as well as the relationship of other organs to the problem of hypertension are now under investigation and we hope to present the final results of these clinical and experimental observations in later more detailed reports

SUMMARY

(1) Thus far the various types of experimental hypertension cannot be said to be completely analogous to clinical hypertension

(2) Experimental hypertension produced by renal ischemia involves an "effective substance" produced in the kidney and most closely simulates clinical hypertension It is not affected by any type of operation upon the sympathetic nervous system

(3) Agreement must be reached among investigators as to the patients who may be included under the term "essential hypertension"

(4) Observations upon patients with hypertension, who are chosen for operation, must be made over long periods pre- and postoperatively

(5) The results obtained by any surgical procedure employed for the relief of hypertension must be explained upon anatomic and physiologic principles

(6) A large number of patients with essential hypertension may be controlled by cyanate therapy so that they can continue their previous social and economic pursuits

(7) Early results thus far obtained suggest a careful investigation of the relationship between the effect of cyanate therapy following splanchnicectomy in cyanate resistant patients

REFERENCES

[1] Rowntree, L G, and Adson, A W Bilateral Lumbar Sympathetic Neurectomy in the Treatment of Malignant Hypertension J A M A, 85, 959, 1925

[2] Heymans, C, and Bouckaert, J J Hypertension arterielle experimentale et sympathectomie Compt rend Soc de Biol, 120, 82, 1935

[3] Goldblatt, H Studies on Experimental Hypertension V The Pathogenesis of Experimental Hypertension Due to Renal Ischemia Ann Int Med, 11, 69, 1937

[4] Freeman, N E, and Page, I H Quoted by Goldblatt [3]

[5] Page, I H, and Sweet, J H Extirpation of Pituitary Gland on Arterial Blood Pressure of Dogs with Experimental Hypertension Proc Soc Exper Biol and Med, 34, 260, 1936

[6] Harrison, T R, Blalock, A, and Mason, M F Effects on Blood Pressure of Injection of Kidney Extracts of Dogs with Renal Hypertension Proc Soc Exper Biol and Med, 35, 38, 1936

[7] Prinzmetal, M, and Friedman, B Pressor Effects on Kidney Extracts from Patients and Dogs with Hypertension Proc Soc Exper Biol and Med, 35, 122, 1936

[8] Barker, M H The Blood Cyanates in the Treatment of Hypertension J A M A, 106, 762, 1936

[9] Freyberg, R H, and Peet, M M The Effect on the Kidneys of Bilateral Splanchnicectomy in Patients with Hypertension Jour Clin Invest, 16, 49, 1937

[10] Peet, M M Presented at Louis Greenfelder Mem Lecture, Chicago, November 23, 1937

[11] Page, I H, and Heuer, G J Treatment of Essential and Malignant Hypertension by Section of the Anterior Nerve Roots Arch Int Med, 59, 245, 1937

[12] Adson, A W, Craig, W M, and Brown, G E Surgery in Its Relation to Hypertension Surg, Gynec, and Obstet, 62, 314, 1936

[13] Hines, E A, and Brown, G E Cold Pressor Test for Measuring Reactibility of Blood Pressure Data Concerning 571 Normal and Hypertensive Subjects Am Heart Jour, 11, 1, 1936

THE CLINICAL RESULTS OF CELIAC GANGLIONECTOMY IN THE TREATMENT OF ESSENTIAL HYPERTENSION

GEORGE CRILE, M D
CLEVELAND, OHIO

IN THE treatment of essential hypertension we have performed 391 operations upon the adrenal sympathetic system in 230 patients These have included 239 celiac ganglionectomies in 144 patients

The effects of unilateral and of bilateral celiac ganglionectomy upon the blood pressure are shown in Tables I to V

An interesting study has been made of the relation of the effects of bilateral celiac ganglionectomy to the age of the patient An examination of Table VI would appear to show that advanced years, in themselves, are no contraindication to operation

A comparison of the effects of celiac ganglionectomy on the blood pressure in cases of hypertension in the malignant and in the nonmalignant phases, indicates clearly that even in cases of advanced malignant hypertension the operation is not contraindicated (Table VII)

In order to see whether or not patients in whom the blood pressure either rose or showed no change in the diastolic pressure during a period of rest in the hospital were worse risks than those in whom the blood pressure fell during the preoperative period, a comparison has been made between the end-results in 15 consecutive cases in which there was either a rise or no change in the diastolic pressure during the preoperative period, and the end-results in 15 cases in which the blood pressure fell before operation Table VIII shows that there is no significant difference between the results in these two groups of cases

An interesting observation is that of this total group six died at varying periods after they left the hospital, and that in three of these six cases the blood pressure had decreased during the preoperative period

The clinical results of these operations on the adrenal sympathetic system are judged (1) By an examination of the eyegrounds, the heart, the kidney function, and the blood pressure of the patient, (2) by knowledge as to whether or not the patient is able to go back to his usual occupation, whether or not the headaches, the dizziness, the failing vision, the precordial pain, the heart-consciousness, and disability have diminished or disappeared The follow-up studies have shown that a fall in blood pressure is not the only criterion upon which to base the effects of any procedure for the treatment of essential hypertension The eyegrounds, the kidney function, the state of the heart, and not the least important, the effects upon the subjective symptoms must be considered As to sclerosis, if it is present at the time of the operation, it will not entirely disappear In Raynaud's disease, ganglionectomy will

TABLE I

EFFECTS OF UNILATERAL CELIAC GANGLIONECTOMY UPON THE BLOOD PRESSURE

	No of Cases	Blood Pressure on Admission	Blood Pressure at End of Period	Difference
At end of hospitalization period	39	210/127	174/109	−36/18
1–3 mos postoper	24	208/126	195/121	−13/5
4–6 mos postoper	9	202/122	172/107	−30/15
7–12 mos postoper	8	194/111	162/95	−32/16
More than 1 yr	4	203/120	171/96	−32/24

TABLE II

REDUCTION OF BLOOD PRESSURE TO NORMAL AS RESULT OF UNILATERAL CELIAC GANGLIONECTOMY

	On Disch from Hosp		1–3 Mos Postoper		4–6 Mos Postoper		7–12 Mos Postoper	
No of cases	39		24		9		8	
Completely normal	41 %		12 5%		22 2%		25 %	
Blood pressure on adm		186/116		171/109		157/107		185/105
Diastolic normal	56 4%		20 8%		42 9%		37 5%	
Blood pressure on adm		196/117		190/114		182/106		195/113
Systolic normal	46 2%		12 5%		22 2%		37 5%	
Blood pressure on adm		188/118		171/109		157/107		178/108

TABLE III

EFFECTS OF BILATERAL CELIAC GANGLIONECTOMY UPON THE BLOOD PRESSURE

	No of Cases	Blood Pressure on Admission	Blood Pressure at End of Period	Difference
At end of hospitalization period	69	220/130	169/111	−51/19
1–3 mos postoper	55	219/135	181/115	−38/20
4–6 mos postoper	33	236/138	191/118	−45/20
7–12 mos postoper	19	221/134	193/119	−28/15

TABLE IV

THE EFFECT OF BILATERAL CELIAC GANGLIONECTOMY UPON THE DIASTOLIC PRESSURE

		Diastolic Pressure Reduced				
	No of Cases	10 Pts or More	20 Pts or More	30 Pts or More	40 Pts or More	50 Pts or More
On Discharge from Hosp	69	73 9%	58 %	40 6%	26 %	14 5%
1–3 mos postoper	55	71 %	58 %	40 %	25 6%	9 %
4–6 mos postoper	33	64 7%	53 %	26 5%	14 7%	2 9%
7–12 mos postoper	19	68 %	47 9%	15 8%	5 3%	0

TABLE V

REDUCTION OF BLOOD PRESSURE TO NORMAL AS RESULT OF BILATERAL CELIAC GANGLIONECTOMY

	On Disch from Hosp		1–3 Mos Postoper		4–6 Mos Postoper		7–12 Mos Postoper	
No of cases	69		55		33		19	
Completely normal	27 5%		18 2%		18 2%		15 8%	
Blood pressure on adm		197/119		192/126		198/122		193/128
Diastolic normal	40 6%		41 8%		30 3%		47 4%	
Blood pressure on adm		213/124		206/124		204/125		215/123
Systolic normal	31 9%		18 2%		21 2%		15 8%	
Blood pressure on adm		200/123		192/126		197/123		193/128

arrest the disease, but the sclerosis of the vessels will remain Sclerosis is widely distributed in domestic animals and in wild animals in captivity Sclerosis appears routinely in the sixth and seventh decades of life It is responsible for the gradual rise in blood pressure with advancing years

In essential hypertension there is a forced speed of sclerosis, due to the pathologic physiology Clearly then, when, at the time of the operation there is present a certain degree of sclerosis, if the pathologic physiology is cured by operation, the patient will be physiologically cured, but, if the sclerosis is sufficiently advanced, the blood pressure does not fall to the normal level, just as the sclerosis of the aged maintains the blood pressure at a higher level than the normal for earlier ages

As the result of celiac ganglionectomy, according to the results in our cases, the subjective symptoms—headaches, nervousness, fatigue, palpitation, dizziness, excitability, irritability, and heart-consciousness—have been relieved over a period of a year in 78 per cent of the patients The eyesight has improved Many patients have been able to return to their normal occupations even though the blood pressure has not been restored to the normal level Even though the blood pressure has been reduced only from 280/150 to 180/120 or 200/130, the subjective improvement may be marked Moreover, these patients tend to become calmer and more equable in temperament and thus even in cases in which the blood pressure remains well above the normal level the violent upsurges of the blood pressure with the disastrous results which may accompany emotional outbursts may be mitigated

An analysis of the negative effects of celiac ganglionectomy also gives significant findings Celiac ganglionectomy does not interfere with metabolism, it does not interfere with the digestive tract, it does not interfere with the genito-urinary tract, there are no orthostatic effects, there are no abnormal changes in the daily blood pressure, there are no changes in the skin, there has been no instance of adrenal insufficiency, there is no change in the rate of activity of the heart, there is no change in sex function

The large majority of the patients operated upon for essential hypertension report a one- to five-year duration of symptoms The duration of symptoms ranged, however, from one month to 25 years Our studies have shown that the duration of symptoms has little effect upon the symptomatic results of celiac ganglionectomy, and our analysis has shown that the same is true for the other types of operation

As for the operative risk among our last 123 celiac ganglionectomies there have been three deaths, a mortality rate of 2 4 per cent The patient with essential hypertension, particularly in the malignant phase, is a poor risk for any impact of life—for any type of fever, for pneumonia, for pregnancy, for muscular exertion, for emotional excitement, in other words, the risk of operation in cases of malignant hypertension is little greater than the risk of life itself

Since, according to vital statistics, 60 per cent of individuals with essential hypertension will sooner or later die of coronary disease, since in essential

TABLE VI

RELATION OF AGE TO THE EFFECTS OF BILATERAL CELIAC GANGLIONECTOMY

	Age 17–29 Yrs			Age 30–39 Yrs			Age 40–49 Yrs			Age 50–61 Yrs		
	Adm	Disch	Dif	Adm	Disch	Dif	Adm	Disch	Dif	Adm	Disch	Dif
On Discharge from Hosp	201/146	176/123	−25/23	225/165	206/122	−19/43	201/146	168/107	−33/39	219/125	167/ 99	−52/26
1–3 mos postoper	224/147	182/128	−42/19	225/149	183/120	−42/29	213/143	190/120	−23/23	212/144	184/120	−28/24
4– 6 mos postoper	220/143	162/108	−58/35	214/131	179/114	−35/17	216/132	180/111	−36/21	221/134	184/116	−37/18
7–12 mos postoper	219/125	167/100	−52/25	212/125	182/113	−30/12	230/126	138/117	−92/9	212/148	189/120	−23/28

EFFECTS OF CELIAC GANGLIONECTOMY UPON BLOOD PRESSURE IN MALIGNANT AND NONMALIGNANT HYPERTENSION

TABLE VII

	No of Cases	1–3 Mos Postoper			4–6 Mos Postoper			7–12 Mos Postoper		
		Adm	Disch	Dif	Adm	Disch	Dif	Adm	Disch	Dif
Malignant hypertension	16	234/148	185/119	−49/29	235/149	198/129	−37/20	229/147	204/123	−25/24
Nonmalignant hypertension	16	221/113	170/107	−51/26	219/131	182/113	−37/18	216/132	185/118	−31/14

COMPARISON BETWEEN THE RESULTS OF CELIAC GANGLIONECTOMY IN 15 CASES IN WHICH THE BLOOD PRESSURE FELL DURING A PERIOD OF REST IN THE HOSPITAL WITH THOSE IN 15 CASES IN WHICH THE BLOOD PRESSURE ROSE

TABLE VIII

	Adm	After Period of Rest		Adm	1–3 Mos Postoper		Adm	4–6 Mos Postoper		Adm	7–12 Mos Postoper	
		Disch	Dif			Dif			Dif			Dif
Rise in blood pressure before operation	224/129	226/145	−52/19	219/126	192/112	−27/14	228/128	194/114	−34/14	202/127	175/107	−27/20
Fall in blood pressure before operation	217/137	181/111	172/116 −45/21	217/137	183/119	−34/18	214/142	188/118	−26/24	216/146	184/124	−32/22

hypertension the heart has tremendous work imposed upon it because of the effort to circulate the blood against the high pressure, one might expect that heart failure would be one of the outstanding risks of the operation In our entire series of cases not a death has resulted from heart failure As soon as either the adrenal gland or the celiac ganglion is interfered with there is a fall in the blood pressure

In 56 5 per cent of the cases in which bilateral celiac ganglionectomy was performed, the blood urea was decreased in 34 8 per cent to the normal level Considering the general mortality from kidney failure and heart failure in cases of malignant hypertension, the low operative mortality is better than what one would expect If in the presence of hypertension one is forced to operate upon the gallbladder or upon the stomach, the burden falls on the brain, the heart, and the kidneys, whereas, when celiac ganglionectomy is performed this burden is lessened and, therefore, it is logical to find a lower mortality from celiac ganglionectomy than from any other operation in the presence of malignant hypertension

One point was made very clear by our experience and that was that when the kidney function is impaired there is very great danger in allowing the blood pressure to fall to too low a level The blood pressure should be maintained at, or above, a certain level, say 100 systolic as a minimum

The question has been raised by clinicians of large experience as to whether the reduction in the blood pressure in essential hypertension may not have a deleterious effect upon certain organs In this regard our experience has shown that there is no risk to the function of an organ in restoring the blood pressure to its normal level In some cases the patients for a time experience a state of diminished energy which is somewhat comparable to the state of transient hypothyroidism

The determination as to the operability of a case of hypertension is in part dependent upon the laboratory findings, and, in a very large part, upon the experience of the operator As to the end-results, in the long run the value of any surgical procedure and medical measure is told by the patient himself If the patient is able to return to his former occupation, if he is relieved of his subjective symptoms, then that determines, and that only, the value of operation The value of the surgical treatment of exophthalmic goiter, peptic ulcer, gallbladder disease—the value of all surgical attempts is determined by the patient No problem is settled until the patient is satisfied

DISCUSSION OF PAPERS OF DOCTORS DAVIS AND CRILE

Dr Francis R Hagner (Washington, D C) —I would like to mention a case which is not my own, but one I saw with Dr David Mackenzie of Montreal, which I do not think has as yet been reported The patient complained of pain over the right eye The blood pressure varied from 129 to 190 After careful study, a diagnosis of adrenal medullary tumor was made He was operated upon, and the left adrenal was examined first, nothing was found Examination of the right adrenal disclosed a cyst, pressure upon which caused the patient's blood pressure to rise to 240 The cyst was re-

moved, and found to contain black fluid The pain disappeared and the patient made a good recovery, the blood pressure had never been over 125 during the first four weeks postoperative

Some time ago I saw an article in the paper about an old gentleman in North Carolina who had had a cardiac attack This problem as we all know, is sometimes difficult It is hard to tell how to treat them This old gentleman was 90, and was married to a lady of 28, and had a child two and one-half years old Six months before he had this cardiac attack he had another child The doctor said he was doing pretty well and they thought he would recover It occurred to me that this case presented a problem in treatment—whether to keep this old gentleman out of bed or in bed

DR F G DUBOSE (Maplesville, Ala) —The last work done by me was on the vegetative nervous system, observations on paravertebral alcohol block for asthma, angina and other conditions

The papers read on this subject impress me with mass production in surgical procedures looking to the remedy of hypertension Interesting indeed are the reported results from the use of the scalpel One is reminded of the shotgun prescription of the early days, when through polypharmacy the chance of a cure might follow From out of this evolved specific therapy, so also, it is hoped from out of the multiple operations, and the many tissues involved, we may progress into a determinative technic The basic element of cause and effect must be kept in mind in all treatment The outstanding work of Crile had proven the rôle the emotions play in hypertension The mental stress or adverse emotional stimuli are well recognized factors in the etiology of high blood pressure How much the personality of the surgeon and the influence of his suggestive powers play in the result of any surgical operation he may do should not be put out of the picture As illustrative of this I would like to report a case of our own Dr J M Mason, Alabama's outstanding surgeon, and in so doing pay a tribute to his outspoken honesty and sympathetic candor in his relationship to those under his care

The patient was a man with hypertension, coronary occlusion and dilatation, and associated sequelae, which made his condition most serious He told him of rest, diet, sensible acceptance of coming under the rules laid down, avoiding worry and cultivation of cheerfulness, insisting that if these were not followed he would certainly die He performed no surgery, yet the convalescence of the man was unexpectedly good, recovering to well nigh normal limits when he was visited by a tragic disaster and added to that a great sorrow During this unfortunate period he had a profuse nose bleed all night, bled white, yet the next day his systolic pressure was 280 Mm Doctor Mason again enjoined absolute rest and an optimistic philosophic responsiveness Under this plan of controlling his emotions putting him *en rapport* with all that touched him, the blood pressure gradually came down to 130 systolic and his recovery was steady and uninterrupted He was given a life expectancy of 18 months in the beginning, but by such temperamental, emotional or psychic adjustment has extended it to six years Had any operation been performed coincidental with the exercise of the surgeon's influence through the faith he commanded, and the wise philosophy exercised it would have been written down as a remarkable surgical achievement I wonder Don't you?

DR MIMS GAGE (New Orleans, La) —I would like to ask Doctor Crile a question We are now operating upon the splanchnic nerves and the celiac ganglia for essential hypertension to obtain reduction of the blood pressure

and relief of symptoms, and as we have no method to determine preoperatively the beneficial results to be obtained by operating upon the splanchnic nerves and the celiac ganglia, would it not be possible, and advantageous, to chemically section the splanchnics with novocain by the method of Kappis, in order to foretell the results which might be expected from the operation?

This method of preoperative blocking of the sympathetics is extensively employed as a routine procedure before any operation is undertaken upon the cervical or lumbar sympathetics in peripheral spastic vascular disease of the extremities, in order that the results to be obtained by their abolition can be predetermined

DR GEORGE CRILE (closing) —The question that was asked me regarding the fall in blood pressure during celiac ganglionectomy is very important It is not only a question of the blood pressure being reduced far enough, but it may be reduced too much In one case the blood pressure was reduced so much that it could not be measured by the manometer We used every means in our power to raise it and finally succeeded after six or eight hours, but during that time the kidneys, which had already been damaged by the hypertension, failed, and we lost the patient This experience taught us to avoid the use of novocain in these operations Manipulation of the ganglion and the sympathetic complex will cause a temporary rise of the blood pressure, but as soon as the celiac ganglion is removed the blood pressure falls often to within normal limits

THE ADVANTAGES OF THE ABDOMINAL APPROACH TO INGUINAL HERNIA

CARRINGTON WILLIAMS, B A , M D
RICHMOND, VA
FROM THE MCGUIRE CLINIC ST LUKE'S HOSPITAL, RICHMOND, VA

THE approach to the sac of an inguinal hernia through the abdominal cavity has been described by a number of authors during the past 20-odd years, but the real advantages of this method have apparently not been widely recognized or appreciated On account of this lack of interest it would seem appropriate for me to review these advantages since two of the advocates of this method are Richmond surgeons

The first reference in the literature to the abdominal approach which I have found is by Dr Charles R Robins[1] of Richmond, Va , who, in 1909, advocated a right rectus incision for the release of strangulated inguinal hernia A few years before, Dr Alexis V Moschowitz,[2] of New York, wrote of operating upon femoral hernia by approaching the neck of the sac above Poupart's ligament, but he did not open the peritoneal cavity other than through the neck of the sac In 1919, Dr G Paul LaRoque,[3] of Richmond, presented modifications of these operations and later, in 1924,[4] 1931,[5] and 1932,[6] discussed its employment in various types of hernia

My interest in this method was first aroused by Doctor LaRoque, and I was easily persuaded to employ it in selected cases after I discovered the ease with which the sac could be removed from above My first experience was with a boy who had mild, acute appendicitis His mother requested that his right inguinal hernia be repaired at the same time I did not agree to this, but when I had removed the appendix the internal opening of the sac was so inviting that I pulled it up, withdrew the whole sac into the peritoneal cavity, cut it off, closed the defect, and did not disturb the inguinal canal There has been no recurrence of the hernia

In the LaRoque operation the usual inguinal incision is made and the external oblique opened into the external ring The internal oblique and transversalis muscles are then opened about one inch above the internal ring as one would in a McBurney incision, and the peritoneal cavity opened The internal opening of the sac is readily seen by lifting upward on the lower leaf of peritoneum Exploration for other openings is quickly made The edge of the internal ring is caught with forceps (Fig 1) and the peritoneum dissected bluntly around its circumference When the peritoneum of the sac is cleared the cord can usually be brushed away from it and the entire sac delivered The excess of peritoneum including the entire sac and its internal opening is cut away The inguinal canal can now be repaired according to the wishes of the operator Finally, the appendix can be removed in most cases when the hernia is on the right side, and the wound closed

There is no particular reason for using this method in the ordinary simple indirect inguinal hernia nor is there any advantage in direct hernia There are, however, six conditions, each of which will be discussed briefly, where it is of real help to the operator

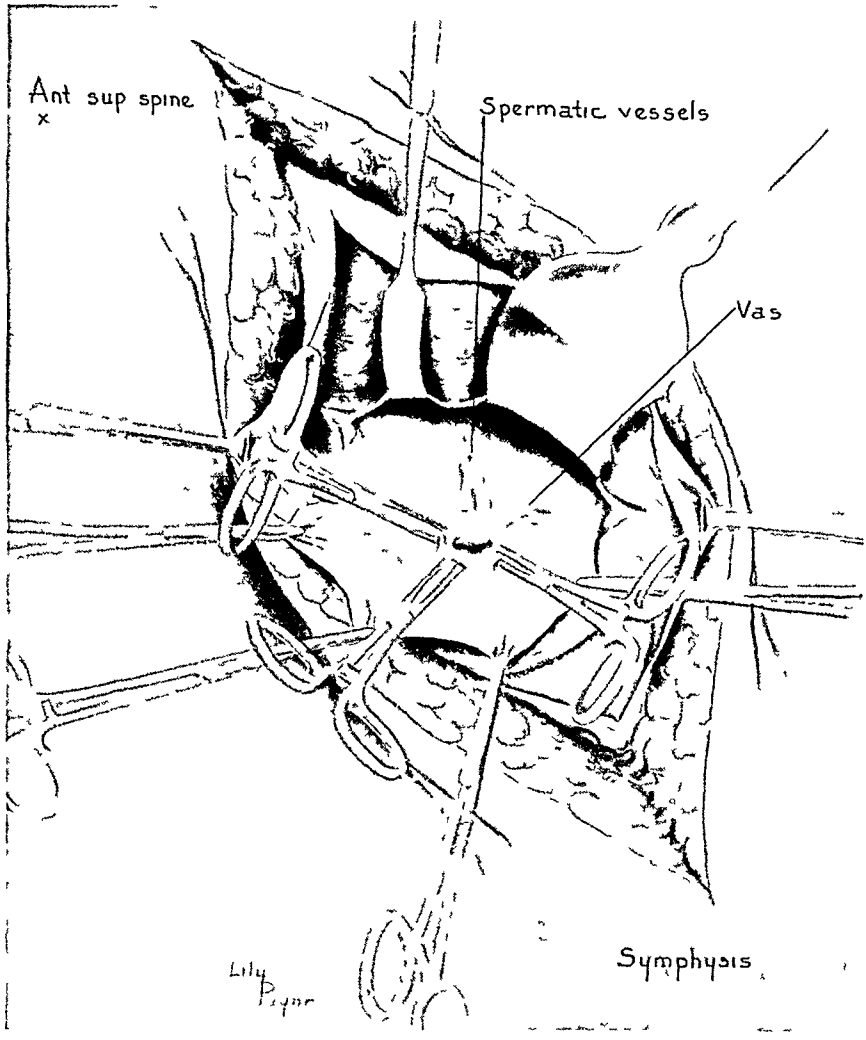


FIG 1.—The internal ring seen from above through the muscle splitting incision (Modified from LaRoque)

(1) The first is when the *appendix should be removed*, or when it is suspected of having been inflamed I have had several cases where the patient attributed pain to the hernia, but a definitely inflamed appendix was removed and was doubtless the cause of the trouble

(2) I advise this approach on all *strangulated hernias* The advantage is that the bowel is entirely under control at all times, the internal ring can be more readily released, and the canal portion of the sac can be opened at the same time if the bowel is caught by a lower ring or is adherent in the sac After the bowel has been released there is sometimes doubt of its viability, with the peritoneal cavity opened the loop can be replaced in the cavity

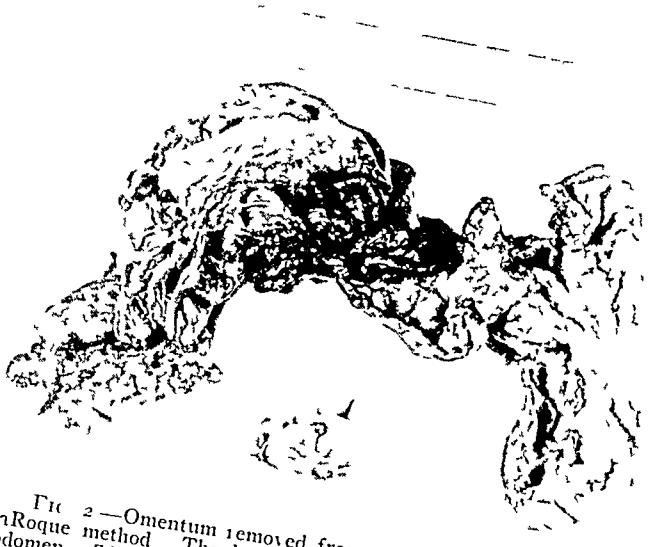


FIG. 2.—Omentum removed from an incarcerated hernia by the LaRoque method. The large dark portion on the left was in the abdomen. The smaller light portion to the right was in the hernia sac.

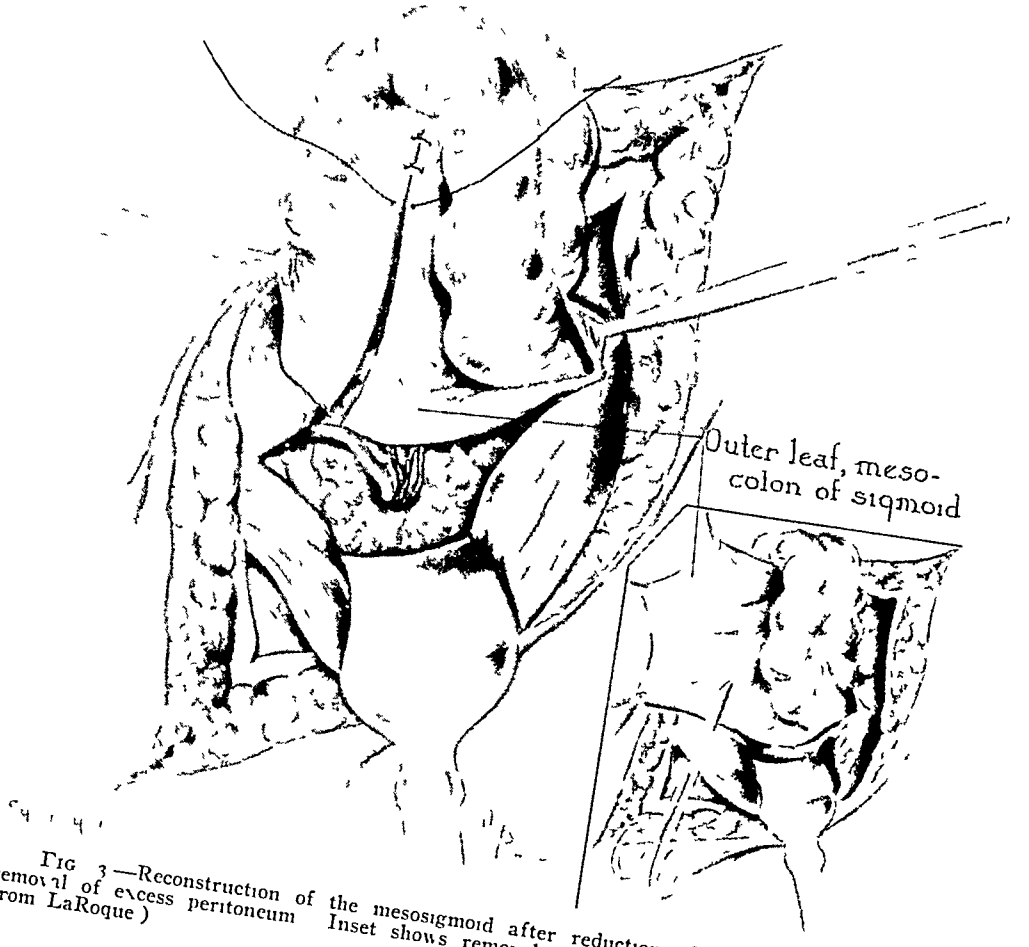


FIG. 3.—Reconstruction of the mesosigmoid after reduction of sliding hernia and removal of excess peritoneum. Inset shows removal of excess peritoneum. (Modified from LaRoque.)

and inspected as desired Finally, if resection is necessary, a good exposure of the mesentery is obtained, while it is often quite difficult through the sac from below

(3) *In large indirect hernias* particularly when there is incarceration of abdominal organs In one case where there was obviously incarcerated omentum in a very fat man, I found a mass of strangulated omentum in the

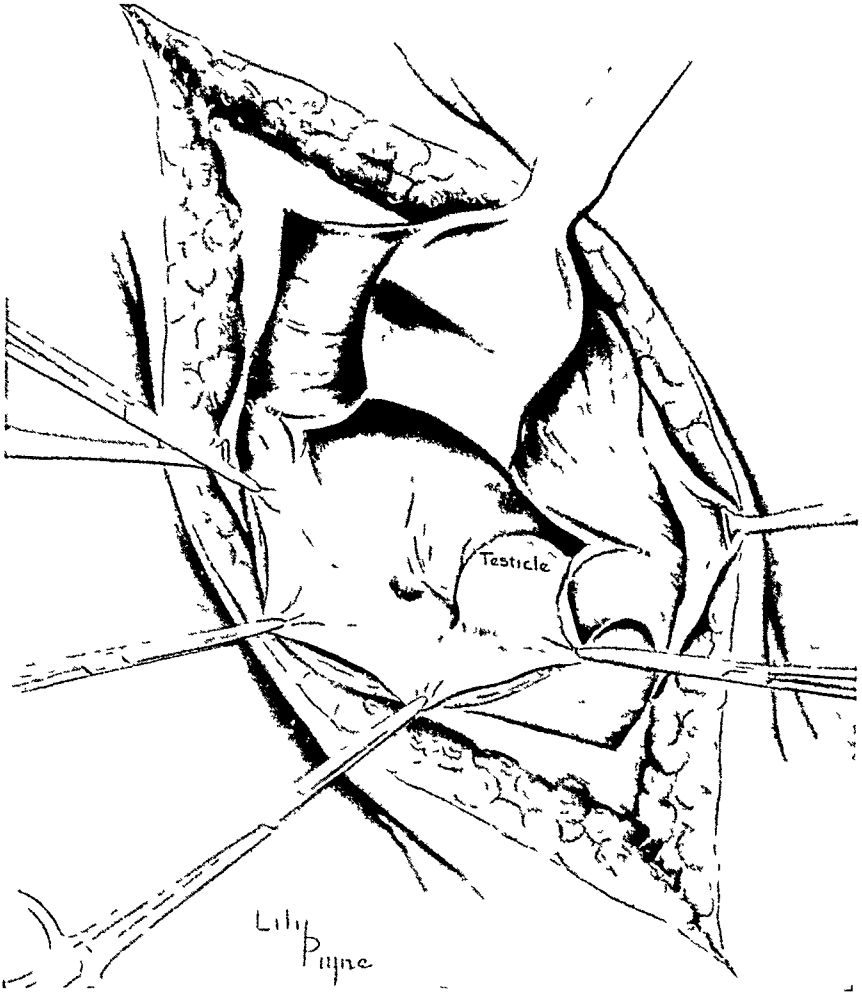


FIG 4.—Internal ring and intra abdominal testicle seen from above through the muscle splitting incision

peritoneal cavity (Fig 2) which was continuous with the healthy omentum of the sac If this hernia had been approached from below, this mass could easily have escaped detection and would certainly have been much more difficult to remove if it had been found

(4) I have not had the opportunity to operate upon a *sliding hernia* through this approach (Fig 3) However, it is easy to visualize the advantage of delivering the sigmoid or cecum from above The incomplete sac can be trimmed to the proper size and its edges used to reconstruct the mesocolon as it should normally have been The cavity would then be

closed and the inguinal canal repaired In women I have found, not infrequently, that the tube and rarely the whole broad ligament has slid into the sac in much the same manner as does the sigmoid and cecum This situation is much more readily corrected through this incision and in any case exploration of the pelvis is possible

(5) *Congenital type of hernia* I have often found it difficult to separate the extremely thin sac of a young child from the vas deferens, and have occasionally been embarrassed by the peritoneum tearing along the vas so that



FIG 5.—After operations by the LaRoque method for bilateral intra-abdominal testicles. Both testicles are in the scrotum

it was quite difficult to close the neck of the sac When approached from above, the neck of the sac can be dissected above the point of contact with the vas so that any tearing would be downward and of no consequence since some of this sac must be left in place With the connection of the sac to the peritoneal cavity broken, it is usually unnecessary to make any repair of the inguinal canal

(6) *Undescended testicle* When once one has approached an undescended testicle from above he will never again try it from below The same ease of dissection of the sac is found here as was described above for congenital hernia The additional great advantage is that the peritoneum can be pushed upward on the posterior abdominal wall and a wider exposure made of the vas and the spermatic blood vessels The adhesions which are so often present can be divided, unimportant veins can be removed, and with

this wider dissection greater length of the cord can be obtained When the testicle is completely intraperitoneal (Fig 4), the hernia sac can be quickly disposed of and then all of its connections are clearly in view and a good cord can be developed I have recently operated upon both sides, with a year's interval, in a boy age 12 (Fig 5) I would not consider any other approach for such a case

I know of few objections to this method and all of them are of slight consequence It is of course a little more time consuming but the few additional minutes rarely make any difference Theoretically, opening the peritoneal cavity more widely and removal of the appendix may result in intraperitoneal adhesions or wound infection Either is too remote a danger to deserve serious consideration under modern conditions

CONCLUSIONS

The abdominal approach to the sac of an inguinal hernia has many advantages which are not generally appreciated It is advocated in cases where the appendix should be removed, in strangulated hernia, in large, complicated, indirect hernia, in sliding hernia, in the congenital type of hernia, and in hernia associated with undescended testicle

REFERENCES

[1] Robins, C R Rectus Incision for Reduction of Strangulated Hernia Old Dominion Jour Med and Surg, 8, May, 1909

[2] Moschowitz, A V Femoral Hernia N Y State Jour Med, 7, 396–401, October, 1907

[3] LaRoque, G Paul The Permanent Cure of Inguinal and Femoral Hernia, a Modification of the Standard Operative Procedures Surg, Gynec, and Obstet, 29, 507–511, November, 1919

[4] Idem An Improved Method of Removing Hernia from Within Annals of Surgery, 79, 375–381, 1924

[5] Idem A Modification of Bevan's Operation for Undescended Testicle Annals of Surgery, 94, 314–317, 1931

[6] Idem The Intra-abdominal Method of Removing Inguinal and Femoral Hernia Arch Surg, 24, 189–203, 1932

DIVERTICULUM OF THE FEMALE URETHRA

WILLIAM E LOWER, M D , AND THOMAS W TORMEY, JR , M D
CLEVELAND, OHIO

DIVERTICULA occur most frequently in the gastro-intestinal and genito-urinary tracts The esophagus, duodenum, and large intestine are the more common locations in the alimentary tract, and the urinary bladder in the urinary system Diverticula of the bladder occur much more often in men than in women In a total of 238 cases which we have observed, only six were in women

Since Sir Charles Mansfield Clark's[1] publication, in 1814, and again 17 years later, of papers dealing with diverticula of the female urethra, increasing numbers of observations regarding this interesting subject have become available Amand Routh,[2] in reviewing the literature up until 1891, found reports of 20 cases, and since that time probably twice that number have been recorded, the majority having been published during the last two decades

Generally speaking, two theories regarding the etiology of diverticula in the female urethra have been advanced (1) The congenital, and (2) the acquired, the latter are divided into traumatic and infectious

Evidence in support of the congenital theory is advanced by Englisch,[3] of Vienna, who reported that he had observed diverticula of the urethra in infants at birth Folsum[4] has reported two cases in which an aberrant ureter opened into a diverticulum Other writers who support the congenital theory delve deeper into the embryology and the numerous possible deviations from the normal

The "acquired" theory has, however, been the most widely accepted and supported Although the condition has been reported to occur in patients at any age from childhood to 60 years, trauma and infection, either separately or together, have most often been associated with the formation of the diverticula Closure of the ducts of the urethral glands resulting in retention cysts which later may become infected and rupture into the urethra is cited as one cause by Amand Routh [2] Trauma to the urethral floor during labor and instrumentation is accepted as the cause by many others

Infection of the urethral glands, although frequently eradicated with difficulty, usually drains into the urethra Obstruction to the drainage with plugging of the glands may result in the formation of an abscess which later may rupture into the urethra and leave a sac-like cavity As suggested by Furniss,[5] some back pressure occurs at each voiding and this may further distend the sac The back pressure takes place because the narrowest point in the female urethra is at the external meatus Secondarily infected blood cysts in the vesicovaginal septum may rupture into the urethra to form a diverticulum

From our own observations in a rather large series of diverticula of the urinary bladder, we believe that most diverticula are secondary to some obstruction to the urinary outflow, not only in the men but in our six cases which occurred in women There were obstructive symptoms in nearly all urethral caruncles, fibrosed bladder neck, congenital stricture of the urethra, *etc*, in the women, and strictures, enlarged prostates, *etc*, in the men While there may be some congenital defect acting as a predisposing cause, the obstruction to the bladder outlet causes the development of most diverticula

From time to time, articles have appeared in which an attempt has been made to determine whether the diverticulum in question is "true" or "false," the determining factor being the presence or absence of a definite muscularis when examined histologically An epithelial lining of the cavity has also been considered as essential if a diverticulum is to be considered as the "true" type Infection frequently erodes and removes the epithelium from the lining of the cavity completely

The term urethrocele, which is so often applied to these cases, would imply a very wide-mouthed diverticulum or a dilatation of a considerable portion of the urethral floor For the sake of simplicity, the definition of a diverticulum of the urethra suggested by Routh[2] might be used "The diverticulum is essentially a urinary pouch or cyst communicating with a urethra of normal calibre, usually in its middle third, by an orifice relatively narrow"

Not all diverticula of the female urethra give rise to symptoms of sufficient severity to cause the patient to consult a physician When medical advice is sought, the symptoms usually consist of frequency and dysuria, a sensation of painful discomfort when sitting, dyspareunia, and occasionally there may be some involuntary escape of urine Examination may reveal a visible and palpable swelling of the anterior wall of the vagina This swelling is cystic in nature and, when acutely inflamed, becomes exquisitely tender Pressure over the mass may force the fluid contents out through the urethra Urethroscopic examination may reveal the site of the ostium in the floor of the urethra—most frequently in the middle third Small catheters or probes may be inserted into the cavity Roentgenologic demonstration of the lesion is easily carried out by filling the diverticulum with a radiopaque substance

Various methods of treatment have been tried, including the injection of sclerosing solutions, incision and drainage, and excision of the diverticulum For consistently good results, excision of the diverticulum accompanied by diversion of the urinary stream by means of an indwelling catheter for a period of five to seven days has been most widely recommended While some authors have allowed the vaginal incision to granulate in the presence of infection, it is felt that almost all these patients convalesce more quickly when the wound is tightly closed or is drained for only a short period of time

The following case of a diverticulum of the urethra in a female has recently come to our attention

Case Report—The patient, a white female, age 52, had had two prolonged labors 26 and 33 years previously No discomfort had been experienced until six years ago,

since which time she had had recurrent episodes of dysuria, and complained of a sensation of soreness in the urethra when sitting

Examination revealed a somewhat cystic, tender mass between the anterior wall of the vagina and the urethra Pressure on the mass caused great discomfort Suspecting the possibility of a diverticulum being present, a urethrogram was made, which showed a diverticulum very definitely situated at about the middle of the urethra Upon urethroscopic examination a small opening could be seen A catheter was passed into the opening and vaginal examination showed it to lie in the mass Probing the pocket with the catheter reproduced the patient's pain

Excision was advised and carried out through an incision in the vagina over the mass The entire diverticulum was removed, the edges of the urethral defect being turned in and the incision closed tightly A gauze roll was inserted in the vagina, in order to exert pressure on the operative site, and this was left in place for 48 hours A soft rubber urethral indwelling catheter was left in place for six days The wound healed perfectly, and the patient's symptoms have been entirely relieved

CONCLUSIONS

We believe that a more careful examination of the urethra should be made in women who have had a prolonged history of irritation during or following urination, and in whom examination has not revealed any special pathology in the bladder It is quite possible that some of these symptoms may be due to a diverticulum of the urethra which has been overlooked

REFERENCES

[1] Clark, Sir Charles Mansfield, cited by Young, B R, and McCrea, L E Urethrocele, Urethral Diverticulum, Suburethral Abscess in Female, Roentgen Appearance, Treatment, Review of Literature, Case, Urol and Cutan Rev, 41, 91–93, February, 1937

[2] Routh, Amand Urethral Diverticula Trans Obst Soc Lond (1890), 32, 69–79, 1891

[3] Englisch, cited by Cone, R E Diverticula of Female Urethra Urol and Cutan Rev, 40, 803–806, November, 1936

[4] Folsum, Alfred, I Discussion, *op cit*, 5

[5] Furniss, H D Diverticula and Suburethral Abscesses in Female Jour Urol, 33, 498–503, May, 1935

Discussion —Dr Guy L Hunner (Baltimore, Md) — Doctor Lower renders a real service in calling attention to this condition of urethral diverticulum, whether it occurs with abscess or cyst formation While a comparatively innocuous condition in some individuals, it is capable of causing great suffering and much ill health, which it does in many cases because of a lack of early diagnosis Doctor Lower's paper has emphasized the ease of diagnosis if one has the condition in mind Many methods of treatment have been proposed, from simple incision and drainage to various modes of thermosurgery I agree, however, with Doctor Lower that the most effectual method consists in excision of the sac and closure of the three layers of tissue for per primam healing

To add interest to Doctor Lower's paper I wish to speak of a rare complication in suburethral diverticulum—that of calculus formation During my first 35 years in gynecologic work, I think I saw at least 12 or 15 cases of diverticulum, without seeing a case of stone in the sac, then in April, 1933, two cases of this rare complication applied to the dispensary service within 48 hours We have had a third case since

Case 1—A white woman, age 77, was admitted April 20, 1933 The younger of her two children had been born 32 years previously For 37 years she had complained of frequency of voiding and occasional incontinence For the past three years the patient had noticed a small nodule in the introitus of the vagina This gradually seemed to grow larger and the incontinence had increased until she was forced to wear a pad on leaving the house

Operation—In addition to excision of the sac with its stones and the usual closure, we shortened the sphincter urethrae muscle by plicating it with a mattress suture of 20-day No 0 catgut She had some difficulty in voiding for the first few days after removal of the catheter, probably due to the shortening of the sphincter, but on dismissal, on the twelfth day, she seemed normal in every way

The suburethral sac contained 17 stones, one measuring 18 Mm, another 13 Mm, and the others less than 1 cm in diameter

Case 2—A colored woman, age 52, was admitted April 22, 1933 She had never been pregnant Her chief complaint was bladder trouble She said that I had treated her for bladder symptoms on three occasions 15 years previously For five months before her admission there had been rather severe bladder symptoms with much straining, and a small lump had appeared in the vulva when she strained On examination, with the patient straining, a protrusion, resembling a cystocele, separated the hymen edges slightly, and on palpation there was apparently a suburethral diverticulum containing a calculus mass measuring about 2 cm vertically and 1 5 cm laterally

I assisted Dr Gerald Hurd, our resident gynecologist, in removing the suburethral diverticulum and the large stone It was a difficult dissection and after removal of the sac we found two rather large openings on the floor of the urethra Each of these was closed with a square figure-of-8 No 0 plain catgut The suburethral layer was closed with interrupted 40-day No 00 catgut An oval piece of vaginal mucosa had been excised with the sac, and the vaginal edges fell together in such good apposition that we decided not to take the third line of sutures but to trust the pressure of the gauze roll in the introitus to result in per primam healing At the time of her dismissal, 23 days after operation, the patient had had perfect control and had no nocturia

Case 3—A colored woman, age 66, applied at the gynecologic dispensary October 15, 1935, complaining chiefly of frequent and painful urination The patient had had two children, the first one 32 years previously A year ago she noticed that whenever she caught cold she developed burning and frequency and had nocturia six to eight times An attack of this character was ushered in with a head cold about two weeks before admission and for two days there was dark red urine with clots

Dr Erle Henriksen, our resident gynecologist, had charge of this case, and he described the suburethral mass as being the size of a pullet's egg There was difficulty in passing the glass catheter, this being facilitated by dragging the sac with its stone away from the symphysis He removed the sac with its stone and closed in three layers The patient was dismissed on the sixth day and returned on the twelfth day free from urinary symptoms

THE MODERN TREATMENT OF VARICOSE VEINS AS INDICATED BY THE COMPARATIVE TOURNIQUET TEST

HOWARD R MAHORNER, M D AND ALTON OCHSNER, M D

NEW ORLEANS, LA

FROM THE DEPARTMENT OF SURGERY SCHOOL OF MEDICINE TULANE UNIVERSITY OF LOUISIANA AND THE HUTCHINSON MEMORIAL CLINIC, NEW ORLEANS, LA

ONE year ago we described a new test[1] for evaluating circulation in the venous system of the lower extremity affected by varicosities, and indicated the significance of this test in directing the proper treatment of varicose veins

The modern trend in the treatment of varicose veins is a combination of ligation of the internal saphenous vein and injection of varicosities with some sclerosing solution A very prevalent teaching concerning ligation is that the internal saphenous vein should be sectioned and ligated high above any of its tributaries in order to keep at a minimum the incidence of recurrence The test which we present shows why this alone is insufficient treatment in many cases of varicose veins, in addition, the test will indicate where the retrograde flow from the deep to the superficial system occurs, *i e*, whether the reflux takes place through the internal saphenous vein alone or through communicating veins from the deep to the superficial system as well

TESTS FOR EVALUATING THE CIRCULATION IN THE VENOUS SYSTEM OF THE LOWER EXTREMITY AFFECTED BY VARICOSITIES

With the several tests which have been advocated for investigating the circulation in varicose veins, the following information should be determined

(1) Competency of the valves in the long saphenous vein

(2) Competency of the valves of the communicating veins

(3) Patency of the veins communicating between the superficial and deep system

(4) Patency of the deep veins

(5) Relative impairment of the arterial supply to the extremity

To obviate unnecessary repetition in describing these tests, which have been previously reported,[1] we will consider only two of them The Trendelenburg-Brodie test, and the comparative tourniquet test of Mahorner and Ochsner[1] The first of these, described initially by Brodie[2] and later, but apparently independently, by Trendelenburg,[3] was employed by Trendelenburg as follows The patient reclines on a table and the leg is elevated so that the veins are above the level of the heart The veins promptly empty The patient assumes the sitting position and then the standing position, and it is noted whether the veins fill quickly or slowly The same performance is now repeated, but after the veins are emptied the hand of the observer is placed over the upper end of the long saphenous vein firmly enough to prevent the passage of blood through it The patient, with this pressure maintained, then sits up and again stands The pressure is maintained only momentarily, and when

released the observer notes the blood as it rushes downward through the internal saphenous system to suddenly distend the varicosities The immediate distension of the veins when the pressure is released indicates incompetency of the valves in the saphenous vein, and in such instances the Trendelenburg test is considered to be positive

A further adaptation of this test is the determination of the so-called doubly positive reaction Instead of releasing the pressure over the internal saphenous vein, the observer maintains it for 35 seconds, to determine if the varicosities distend in spite of the continued pressure over the saphenous vein If the varicosities become distended to their full prominence within 35 seconds, it indicates that the blood, unable to return through the saphenous vein with its incompetent valves, has found another shortcut by way of the communicating veins, whose valves, therefore, must have become incompetent since the flow through these communications is normally from the superficial to the deep system If the varicosities take 35 seconds or longer to distend fully, with the observer exerting pressure over the internal saphenous vein, the interpretation is that the valves of the communicating veins are competent The blood, not being able to return through the varicosed saphenous vein with incompetent valves because of pressure exerted by the observer, and not being able to return through the communicating veins because their valves are competent, must, therefore, reach the varicosed superficial veins by the normal route passing through the capillaries, and it requires approximately 30 seconds for sufficient blood to do this in order for it to distend large varicosities

The comparative tourniquet test described by Mahorner and Ochsner[1] combines the advantages of the several other tests and when correctly interpreted gives one extensive information concerning the condition of the circulation in the varicose veins of the lower extremity

The patient is observed standing, draped so that the two legs and thighs can be seen The observer sits with the light behind him and with the level of vision low so that the veins of the calves and thigh can be easily seen The patient walks to and fro in front of the observer (Fig 1) Even with no tourniquet on the varicosities become less prominent when the patient is walking, because the peripheral pumping action of the muscles on the deep veins sucks the blood from the superficial system and helps return it to the heart The patient then stops and a tourniquet is applied around the upper third of the thigh sufficiently tight to compress the superficial veins and obstruct the flow of blood through that segment The patient walks again over the same course and at the same speed The prominence of the varicosities is noted and compared with their prominence when walking without the tourniquet and again when walking with the tourniquet around the middle third of the thigh and again when walking with the tourniquet around the lower third of the thigh The prominence of the varicosities is thus observed under five different conditions Standing, walking without the tourniquet, walking with the tourniquet around the upper third of the thigh, around the

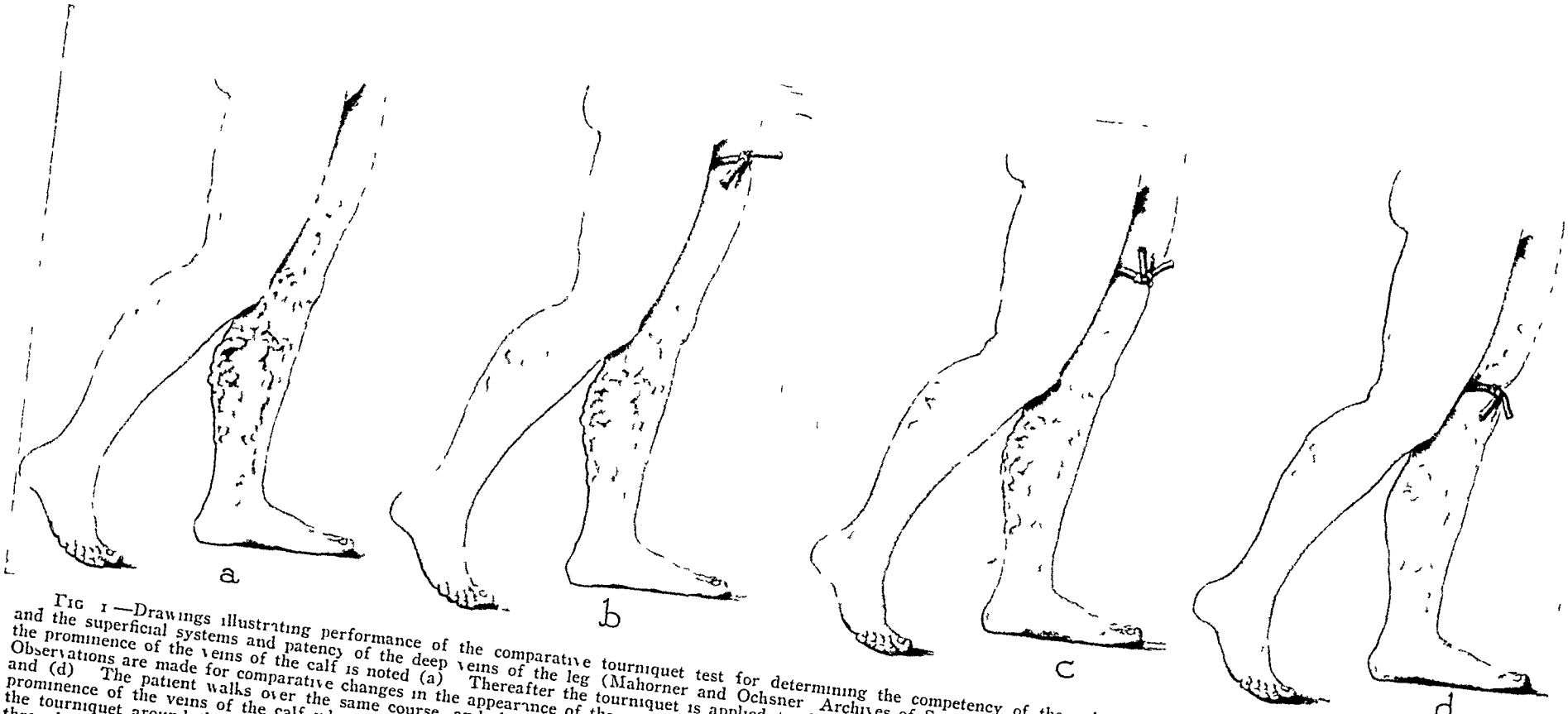


FIG. 1.—Drawings illustrating performance of the comparative tourniquet test for determining the competency of the valves of the veins communicating between the deep and the superficial systems and patency of the deep veins of the leg (Mahorner and Ochsner, Archives of Surgery, 33, 479–492, 1936). The patient walks at a normal gait, and the prominence of the veins of the calf is noted (a). Thereafter the tourniquet is applied to the upper third of the thigh (b), sufficiently tight to compress the superficial veins. Observations are made for comparative changes in the appearance of the veins of the calf. The tourniquet is likewise applied to the middle and the lower third of the thigh (c) and (d). The patient walks over the same course, and the prominence of the veins is noted. If the deep and communicating veins of the thigh are patent there is diminished prominence of the veins of the calf when the patient walks with the tourniquet applied. If the valves of the communicating veins are incompetent when the patient walks with the tourniquet around the upper third of the thigh, there is some diminution in the prominence of the varicosities, but they do not entirely disappear because the blood spills through the incompetent communicating veins from the femoral to the long saphenous vein. When the tourniquet is below the lowest communicating vein of the thigh in which the valves are incompetent (d), the varicosities of the calf collapse or disappear. When valves of the communicating veins are incompetent high ligation alone is not sufficient, and low ligation also must be performed to interrupt retrograde flow through communicating veins. If the varicosities of the thigh and leg completely collapse, *i.e.*, disappear, when the tourniquet is around the upper third of the thigh and there is no further improvement when the tourniquet is around lower levels, then the valves of the communicating veins are competent and high ligation and section of the saphenous vein are sufficient to interrupt the retrograde flow from the deep system. In (b) slight improvement (diminution in prominence) is shown over that indicated in (a), in a case in which the blood spills through the communicating veins below the level of the tourniquet. In (c) more improvement in the veins of the calf is shown and in (d) the greatest improvement appears. If the improvement shown in (b) were complete, the test would indicate competency of the valves of the communicating veins of the thigh but incompetency of the valves of the internal saphenous vein.

middle, and around the lower third of the thigh When the patient walks with the tourniquet applied, the varicosities are less prominent than when standing still or walking without the tourniquet, but in certain instances there are different degrees of improvement with the tourniquet at different levels (Fig 2-A, B, C, D, E, F)

The interpretation is as follows If there is greater improvement (less prominence) in the varicosities below the tourniquet when the tourniquet is around the lower third of the thigh than when it is around the upper third, it is evident that not only is there a retrograde flow from the deep to the superficial system through the main opening of the internal saphenous, but that there is also a reflux through communicating veins below the level of the fossa ovalis (Fig 3) If a maximum improvement occurs when the tourniquet is at the highest level, that is, around the upper end of the internal saphenous (Figs 4 and 5), and there is no further improvement when the tourniquet is around the middle third or around the lower third of the thigh, then only one source exists for retrograde flow into the superficial system of veins and that source is through the main opening of the internal saphenous into the femoral (Figs 4 and 5) There is never a greater diminution in the size of the varicosities when the tourniquet is in the upper third than when it is in the lower third of the thigh It does sometimes happen that the veins *above* the tourniquet, when it is around the lower third, are more prominent than the same veins when the tourniquet is around the upper third In severe cases this is expected and does not vitiate the test The test depends upon the condition of the varicosities below the tourniquet

In interpreting the test, Grade IV improvement means complete or practically complete disappearance of the varices, Grade I, slight, II, moderate, and III, marked improvement Of course, improvement indicates diminution in the pressure in the veins and in some instances where the vein walls are extremely thick the improvement may be detected more accurately by palpation then by vision The improvement is recorded for each level If the improvement on the right leg is Grade IV in the upper third and Grade IV in the lower third (Figs 4 and 5), ligation at the highest level will accomplish complete obstruction to the reverse flow of blood If in the same individual the other leg shows a Grade II improvement with the tourniquet in the upper third, Grade III in the middle, and Grade IV in the lower third (Fig 2), then there must be incompetency not only of the valves in the saphenous vein but also of the valves of the veins communicating between the deep and superficial systems of the thigh (Fig 3) Though high ligation will suffice in the right leg of this patient it will be insufficient to stop the retrograde flow in the left leg Something additional must be done It is not feasible to ligate, independently, each communicating vein as was attempted by deTakats and Quillian [4] This converts the operation into a major procedure and extirpation of the veins by any of the described methods has been discarded because of the severity of the procedures and because of the mortality We believe, because of our experience and that of others, that low ligation alone is not



Fig. 2.—Enlargements from moving picture (A B C) Patient before treatment showing huge varicosities in the left leg, some on the right (D E F) The improvement in appearance of varicosities during the comparative tourniquet test D is walking with the tourniquet high E around the middle of the thigh and F around the lower third of the thigh all sufficiently tight to compress the superficial circulation Notice that the prominence of varicosities is less marked with the tourniquet around the middle and lower thirds (E F) of the thigh than when the tourniquet is around the upper third as in D The valves of the communicating veins in this thigh are thus shown to be incompetent G the patient ten days after ligation and section of the internal saphenous at the fossa ovalis H, patient ten days after an additional low ligation in the lower third of the thigh I patient one month after completion of high and low ligation of the left saphenous vein and high ligation of the right saphenous vein

sufficient because in a high percentage of cases recurrences readily take place through collaterals subsequently[5] If high ligation is performed to prevent recurrences, low ligation should also be made in these instances to completely obstruct the retrograde flow from the incompetent valves of the com-

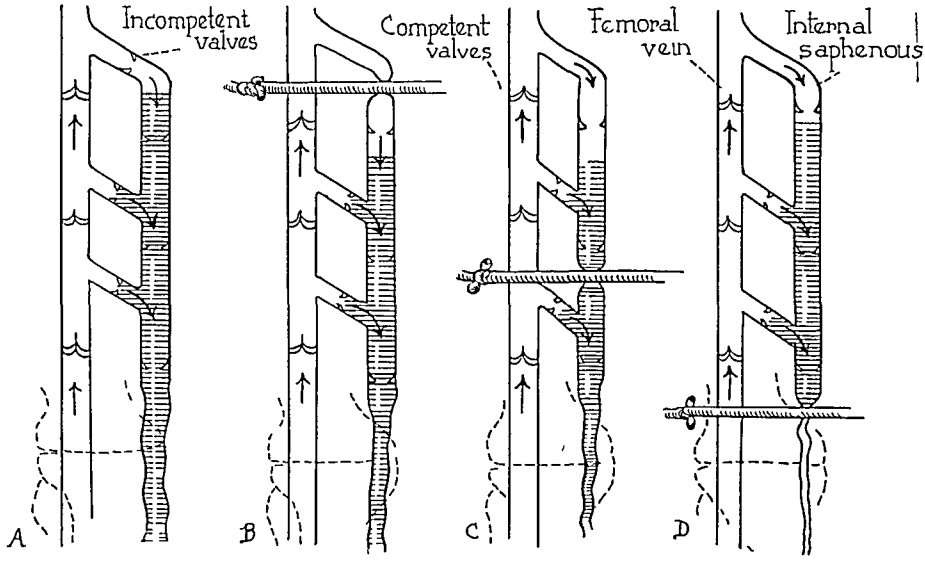


FIG 3.—The physiology involved in the comparative tourniquet test in the left leg of the patient shown in Fig 2, that is when the valves of the communicating veins as well as of the internal saphenous are incompetent When the tourniquet is high it stops retrograde flow through the internal saphenous but there is an abnormal flow from the deep to the superficial systems below the tourniquet through the communicating veins and only when the tourniquet is below the lowest communicating vein with incompetent valves, as in D, is there collapse of the varicosities

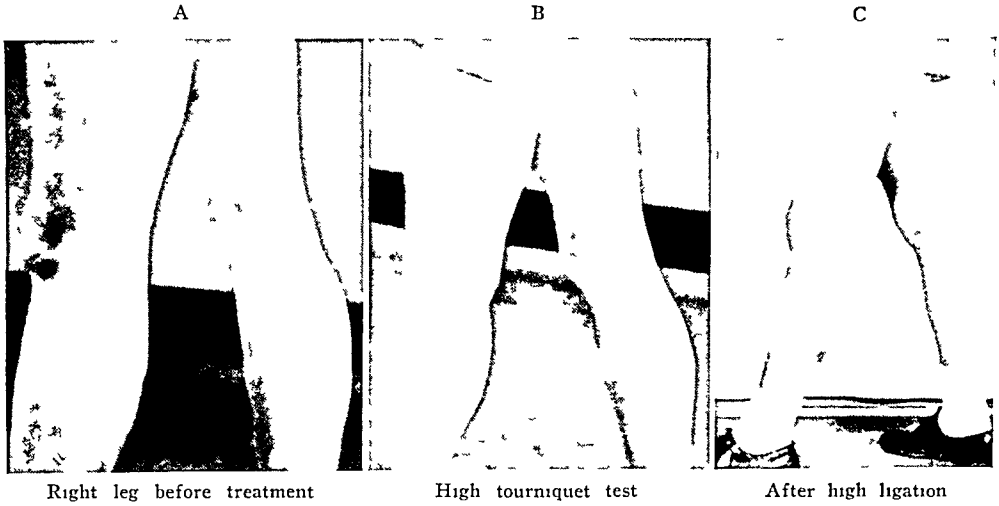
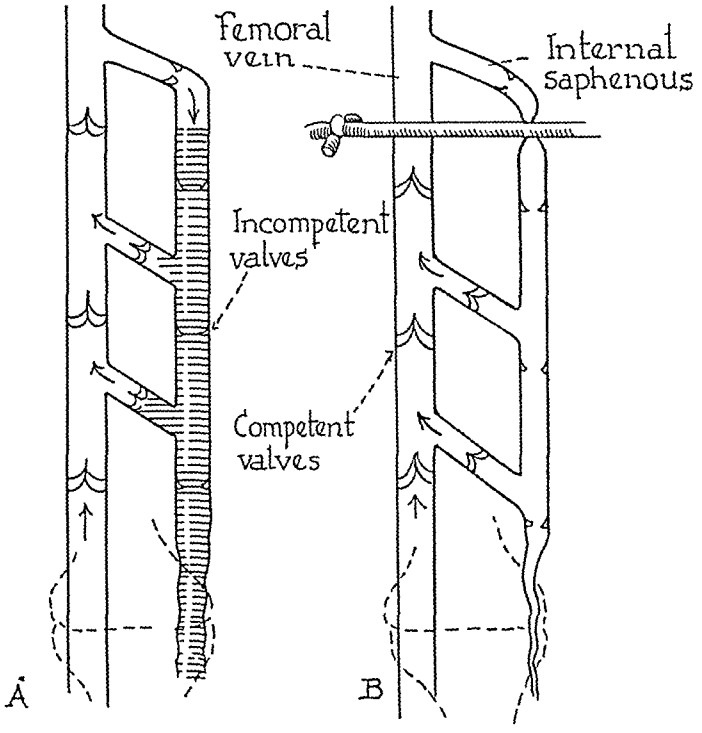


FIG 4.—Enlargements from moving pictures Same patient as in Fig 2 (A) the varicosities of the right leg before treatment (B) before treatment the patient walking with the tourniquet high on the thigh The varicosities have entirely disappeared thus showing that although the valves of the saphenous vein are incompetent, those of the communicating veins are competent and high ligation alone is sufficient to interrupt the retrograde flow from the deep to the superficial system (C) ten days after high ligation and section of the right internal saphenous vein

municating veins It is true that high and low ligations do not preclude the possibility of recurrences through collateral channels around the lowest transection and ligation, but such a possibility is more acceptable than the complete removal of the saphenous vein because the latter is a more formidable operation with a probable, similar incidence of recurrence, and a probable, greater risk (Table I) "Probable" is used advisedly because of the difficulty of estimating recurrences and mortality from available statistics

In rare instances the improvement with the patient walking and with the



Valves of Internal Saphenous Vein Incompetent

FIG 5.—Physiology involved in the right leg of the patient shown. When the tourniquet is placed high there is complete collapse of the varicosities since the valves of the communicating veins are competent and since retrograde flow which is occurring through the saphenous vein alone is abstructed (Compare with Fig 3.)

tourniquet around the thigh is not complete, that is, cannot be graded IV with the tourniquet around even the lower level of the thigh There still must be a leak below this tourniquet and this is either directly through the external saphenous system from the popliteal (usually when the external saphenous system in varicose it is due to its connection with the internal saphenous) or through the communicating channels between the deep and superficial systems of the calf These two sources may be differentiated by putting a tourniquet around the leg below the knee and at the upper end of the external saphenous vein If reverse flow is occurring through the external saphenous directly from the popliteal, further improvement of the veins of the leg is found when the tourniquet is placed around the upper end of the external saphenous We have encountered this condition only rarely Leakage through the communi-

cating veins of the calf (very rare) from the deep to the superficial systems will not be retarded when the tourniquet is placed around the leg below the knee

The comparative tourniquet test[1] combines the advantages of other tests localizing accurately the veins with incompetent valves It gives the following information

(1) Whether the valves of the internal saphenous vein are incompetent

(2) Whether the valves of the deep veins communicating between the deep and superficial system are incompetent, and where they are incompetent

(3) Whether there is a direct leak from the popliteal vein into the external saphenous vein

(4) Whether the communicating veins and the deep veins are patent

The use of this test safely permits the abrogation of all the other tests except the Trendelenburg-Brodie The Trendelenburg-Brodie test, by noting the rapidity with which the blood rushes into the varicosities when the pressure is released, gives a better idea of the degree of incompetence of the valves The doubly positive reaction of the Trendelenburg-Brodie test is not so reliable in detecting incompetence of the valves of the communicating veins as is the comparative tourniquet test In a group of varicose extremities we found the valves of the communicating veins to be incompetent in 20 per cent by the doubly positive reaction of the Trendelenburg-Brodie test, and in 33 per cent by the comparative tourniquet test in the same group of extremities[5] Moro,[6] in 1910, found that 55 per cent of 42 cases had retrograde flow not only through the main opening of the saphenous but also through the communicating veins, basing his conclusions upon the recurrences he had after the Trendelenburg operation and the presumption that recurrences meant retrograde flow through the communicating veins, which of course they do not invariably indicate However, this is the only other estimate we have found besides ours of the relative percentage of leaks through the main opening of the saphenous and through the communicating veins as well

Historic Notes on the Operative Treatment of Varicose Veins—Numerous operative procedures have been advocated for varicose veins It is difficult to evaluate, impartially and correctly, the comparative results of these different methods The following are, however, among the noteworthy contributions

Schede,[7] in 1877, described one of the first attempts to perform an operation which would be acceptable from the standpoint of completeness of cure absence of recurrences, and untoward results He used principles which had already been employed, but used them much more extensively than formerly He ligated and sectioned the long saphenous vein in the lower third of the thigh In those cases in which the wall of the veins was thin and in which, because of the thinness, it would be difficult to separate the vein from the perivenous structures, he used percutaneous ligation He passed catgut sutures through the skin and under the varicosities in many places and tied the

sutures over a rubber tube the thickness of a finger He has used as many as 30 ligatures in a single case Of course, there were many recurrences and this procedure gained no favor

Madelung[8] described, in 1884, a procedure which consisted of complete excision of the long saphenous and varicose radicals and ligation of the remaining stumps through a long incision on the thigh and the leg The Madelung operation has been one of the most popular of the radical procedures for varicose veins It has the disadvantage, however, of being an extensive operative procedure, requiring hospitalization and being attended with a mortality of approximately 0 7 per cent from pulmonary embolism[9] The principle of the operation is good but has the same fundamental objective as other procedures described at the beginning of the present century (Keller's,[10, 11] Mayo's,[12] and Babcock's[13]) operations, in all of which the vein is removed In the same article in which Trendelenburg described a test for reversal flow of blood in the long saphenous system, he advocated ligation of the saphenous vein and section of it, but the point of election for him was not high on the vein but where it was prominent in the middle of the thigh Perthes[14] reported results from this procedure and found recurrences in 22 per cent

In the early part of the nineteenth century several important advances were made in the treatment of varicose veins Tavel,[15] in 1904, suggested the treatment of varicosities by a combination of ligation and injection If spontaneous thrombosis did not occur within 24 to 48 hours after low or high ligation of the long saphenous vein in the thigh, he injected the vein with 5 per cent phenol Ligation and section alone resulted in thrombosis in only seven of 25 cases He thought that artificial thrombosis would reduce the percentage of recurrences following ligation In 1912, he[16] reported 50 cases which had been treated by this method Though Tavel used the ligation and injection treatment with a period of time intervening, to Schiassi,[17] belongs the credit of introducing simultaneous injection at the time of ligation Schiassi ligated the long saphenous just above the knee, but when he sectioned the vein he introduced an olivary-tipped glass cannula with an adaptor fitted to a syringe, and injected 30, 40, or 50 cc of a solution containing iodine Gm 1, potassium iodine gram 1, and distilled water 100 cc into the distal stump Modifications of this method have been employed widely throughout the world and it is increasing in popularity Excellent results have been reported from its use by Mazzini,[18] Foa,[19] Putzu,[20] and Schiassi[21] Nobile[22] modified Schiassi's method by injecting the saphenous vein distally just below the groin and permitting the solution to flow out of the open vein above the knee Unger[23] modified this method by introducing a ureteral catheter into an incision high in the internal saphenous vein, and as the catheter was slowly withdrawn 1 to 2 cc of 20 per cent sodium chloride or a sugar solution were introduced for every 5 to 10 cm of vein

To return now to an earlier period and to the development of a different type of treatment of varicose veins, one finds that several ingenious instruments and methods were devised for complete removal of the varicosed long

saphenous vein without the necessity of making a long incision as used by Madelung Keller,[10] in 1905, described removal of segments of vein by passing a wire loop through the lumen, cutting the vein at a distance lower down and tying the tip of the obliquely severed vein to the wire loop The wire was then withdrawn, the vein segment inverted, and dragged out through its own lumen He[11] later added mass transfixion of tissues in the region of the vein bed after extraction of the vein In 1912, he reported 33 cases in which the results were all satisfactory

In 1906, C H Mayo[12] described an instrument for enucleating the vein through a small incision It consisted of a small ring on a long handle The incision was made low over the vein and the proximal end of the severed vein was threaded through the ring, and by forcibly shoving the instrument up the tautly stretched vein it was torn from its surrounding connections up to another level where an incision was made and the segment was detached The remaining stump of the varicose vein was ligated In the following year, Babcock[13] introduced a modification of the Keller method Through an incision in the vein he introduced an acorn-tipped guide and passed it through the vein, and at the distal end another incision was made The vein was severed and the distal end of the segment tied to the tip of the guide The guide was then withdrawn, the vein with it being pleated on the handle of the guide The disadvantage of these measures was that there were left many large, lacerated communicating veins in which thrombi were likely to form with the possibility of extension into the deep venous system

In 1908, Friedel[24] described an operation that was devised and used by Rindfleisch, and which eventually proved to be one of the most atrocious crimes a heavy handed surgeon even inflicted on his patients The operation which fortunately was reserved for severe cases of varicosities consisted of excision of the internal saphenous vein in the thigh and a spiral incision through the skin and subcutaneous tissue down to the deep fascia, beginning at the knee, encircling the leg four to seven times, and ending at the foot The bleeding superficial veins were ligated and the wound was packed open, making a deep gutter, which necessitated healing by second intention Friedel[24] reported seven cases with two recurrences Meyer,[25] in 1914, reported 42 per cent permanently healed cases and, in 1924,[26] 28 cases with the following results One death from sepsis, and three other deaths within a year, the cause not given Of ten cases which he followed for from one to ten years, only seven had a satisfactory result, but as the picture from Friedel's article showed, the optimum result appears atrocious Fortunately, only Rindfleisch's and Bircher's clinics found this operation acceptable enough to give any expression of approval

Tavel,[15] in 1904, and Homans,[27] in 1916, called attention to the advisability of ligating the internal saphenous high above any of its collaterals in order to prevent recurrences This very important point is still not sufficiently appreciated In cases in which the Trendelenburg test is doubly positive, indicating incompetency of the valves of the deep communicating vein, Ho-

mans[27] recommends extirpation of the vein deTakats,[28] in 1930, suggested that ligation of the saphenous vein could be done as an ambulatory procedure, which has proved a noteworthy contribution From our own experience and from an exhaustive review of the literature, we believe that thrombus propagation and embolus are greatly diminished and prevented by the patient being active We have found no deaths from embolus recorded where this method has been properly used Faxon's[29] patient died, but the patient had been put to bed

Modern Treatment—A variety of measures are used for treating varicose veins of the lower extremity, and the indications for selecting a method or combination of measures for a particular case vary because of the many factors involved The following methods, either because of their efficiency or because of various reasons why they should not be used, are worthy of discussion

(1) Preventive treatment—rest, external support
(2) Conservative treatment
 (a) Rest and elevation
 (b) Elastic supports
 (c) Unna's paste boot
(3) Injection treatment—use of sclerosing solutions intravenously without operation
(4) Operative treatment
 (a) Extirpation
 Madelung's operation
 Mayo's operation
 Keller-Babcock operation
 (b) Schede operation
 (c) Ligations—single or multiple
 (d) Ligation and simultaneous or preliminary or subsequent injection of sclerosing solutions

Selection of the proper treatment for the individual case not only calls for considerable knowledge and judgment, but should evoke a fairness in evaluating the different measures rather than persistence in blind adherence to a particular type of therapy

Contraindications to Active Treatment—In considering the applicability of a measure a number of points must be weighed, among the most important of which are the age of the patient, the existence of pregnancy, the presence of any debilitating disease, the existence of any severe impairment in arterial blood supply to the part, the study of previous or coexistent phlebitis, and the presence of pelvic tumors or other mechanical obstruction to venous flow The above conditions may be actual contraindications to the active treatment of varicose veins, there are none to the conservative treatment, which consists of rest and elevation or external support alone

(1) *Advanced Age*—Senility, in which the mental or physical condition of the patient promises less from alleviation of varicosities by active measure

than by a simple compression bandage either in point of time (life expectancy) or in faculty of appreciation (the mental ability to do so), may be a contraindication to the active treatment of varicose veins

(2) *Pregnancy* is more an indication for conservative treatment than it is a contraindication to active treatment Better expressed, it is an indication for delayed active treatment The facts leading to this conclusion are Varicose veins appear or are made worse by pregnancy Frequently the patients first present themselves for treatment during pregnancy, and it may appear difficult from the intrinsic standpoint of the physician alone to instruct that patient concerning the conservative measures and advise her to return later after the puerperium for the actual treatment of the varicosities Some of these patients will never submit to active measures later, though such treatment may be advisable, and this small percentage is perhaps the only argument for immediate active treatment On the other hand, since varicose veins become worse during pregnancy, there is the probability that a goodly number of patients treated at this time may have recurrences even before parturition Some few patients will have such a marked abatement of varicose veins after the puerperium that they are practically normal and need very little active treatment In these, the conservative measures (supportive bandages or stockings) are, indeed, preventive measures which in pregnancy also consist of rest in bed and elevation of the legs during the middle of the day The records of the Hutchinson Memorial Clinic of Tulane University School of Medicine show 285 cases of varicose veins diagnosed at the clinic between September 19, 1932 (when it opened) and January, 1936 There were 9,233 patients registered during that time Thus one in 32 admissions had varicose veins (3 per cent) One hundred fifty of these varicose vein patients were seen in the Department of Obstetrics alone and did not come to surgery, though others did from that department There was a total of 1,419 pregnant women seen by the Department of Obstetrics during that time Thus approximately 10 6 per cent of pregnant women showed varicose veins, and 53 per cent of varicose vein cases were pregnant Pregnancy was the main reason these 150 patients came to the clinic and varicose veins was only an associated condition Yet this group represented 52 per cent of the cases of varicose veins registering during that period, and few of these had severe enough varicosities after parturition to make them seek treatment for their veins The inference is striking, *i e*, supportive treatment but not active during pregnancy for this group, active treatment for those that need it in the puerperium Occasionally, in severe cases, it may be advisable in the early months of pregnancy to use active measures to treat the varicosities

(3) The presence of certain *debilitating diseases* is a contraindication to the active treatment of varicose veins It may seem needless and pedantic to mention that patients with metastatic carcinoma or other diseases in which the life expectancy is short should have only conservative treatment for varicosities Conditions such as severe anemia, diabetes, cardiac affections and

pulmonary disease should be corrected or under absolute control before active treatment of varicosities is undertaken

(4) The existence of any severe *impairment to the arterial blood supply* may be a contraindication to active treatment of varicose veins Ligation of the saphenous vein for varicosities may greatly improve the circulation to an extremity in which it is impaired not only by varicose veins but also by arterial sclerosis, and the extremity may be benefited by ligation On the other hand, in the extremity in which the blood supply is very deficient, any accident such as infection or excessive thrombosis may precipitate a disaster, the possibility of which causes one to hesitate to employ any radical treatment The injection treatment is possibly even more dangerous to these individuals than high ligation alone, because the injection of sclerosing solution may precipitate excessive thrombosis, causing reaction and edema with which a poorly nourished extremity could not adequately contend Even with ligation, about 25 per cent of the cases will have a peripherally propagating thrombus which may also be dangerous for similar reasons Therefore, extreme caution should be employed for cases affected with arteriosclerosis, and because of the nature of thrombo-angiitis obliterans active treatment would always be extremely dangerous In considerable experience with both conditions, we have rarely seen thrombo-angiitis obliterans and varicose veins associated

(5) The history of *previous or coexistent phlebitis* may be in the former, and is in the latter instance a contraindication to the active treatment of varicose veins Active phlebitis of the deep veins is a contraindication to active treatment being directed to the care of varicose veins Infective thrombophlebitis may be disseminated by active treatment (Hanschell[30]) How long one should wait after an attack of phlebitis of the deep veins before the active treatment of varicosities is undertaken is a debatable question Six months is a minimum period Where a deep phlebitis has left a residual obstruction to the deep system, which is detectable by the comparative tourniquet test, it is not permissible to obstruct the superficial system either by ligation or injection However, an obstruction to the deep veins following a recent phlebitis may clear up after a sufficient length of time (six months to two years)

(6) *Tumors of the pelvis* or other mechanical obstruction to the return venous flow, even if not an actual contraindication to the active treatment of the varicose veins, should be corrected before the varicose veins are treated In the interval conservative measures may be employed

Selecting the Type of Treatment for the Case—In selecting the type of treatment best suited for a case we will consider, individually, the four categories of treatment and the type of case which should be managed by each method

(1) *Preventive Treatment*—Preventive treatment is most frequently indicated in pregnancy The obstetrician should instruct patients who have

any predisposition to varicose veins in the preventive measures These are rest in bed in the midday or midmorning and midafternoon for at least a half hour with the legs slightly elevated The patient should wear bandages or elastic stockings if varicosities are present

(2) *The Conservative Treatment* is merely supportive Presumably the existence of varicose veins is indication enough for therapy, but because of contraindications active treatment is not always feasible Such cases are those in which age, severe concomitant diseases, arteriosclerosis, *etc*, make active treatment inadvisable and cases in which pelvic tumors, phlebitis, pregnancy, make the delay of active treatment advisable

Technic of Conservative Measures—Bandages consisting of cotton fabric, woven so that there is some elasticity, or silk with fine elastic threads incorporated, are used There are several varieties Bandages are usually five yards in length and vary in width Three and four inch widths are the best sizes Proper application consists of one turn about the ankle, then one or two turns around the foot, returning to the ankle and wrapping spirally up the leg to just below the knee, wrapping each previous turn one-half the width of the bandage In some instances two bandages are necessary for one leg, the additional one beginning below the knee and continuing up the thigh The bandages are applied in the morning and removed at night before retiring The commonly employed "Ace" bandage is excellent for this purpose

Elastic stockings generally contain some rubber They may be effectively used in some cases where the conservative treatment is indicated The heavy ones have a tendency to roll into creases For prolonged use in weather which is not uncomfortably hot they are probably more satisfactory to the patient than bandages There are several varieties and makes, heavy mercerized cotton and rubber or heavy silk and rubber One of the best varieties, the one we prefer, is the "Lastex," (Bauer & Black) It is thin but effective and scarcely shows under other stockings The preferable type contains heel and toe, and may be a short one stopping below the knee or the longer stocking which goes to midthigh Doctor Scholl's is another satisfactory one

Unna's paste boot is indicated in the preliminary treatment of varicose ulcer, *not* in uncomplicated cases of varicose veins where bandages and elastic stockings better serve the purpose

Rest and elevation of the lower extremities are adjuncts to supportive measures The patient is instructed to recline at midday or in midmorning and midafternoon and elevate the legs slightly on pillows, resting at least one-half hour each period This is especially indicated in those cases complicated by edema or ulceration

(3) *Treatment by the Injection of Sclerosing Solutions Only*—The selection of cases for treatment by the injection of sclerosing solutions, and the use of this measure without operative treatment, involves the difficult problem of comparing the value of this method with the combination of an operative measure and the injection of sclerosing solution This comparison must take

into consideration the late as well as the immediate results, the mortality, the ease of administration, and relative discomfort to the patient

TABLE I

RÉSUMÉ OF STATISTICS RELATIVE TO MORTALITY, RESULTS AND RECURRENCES (COMPILED FROM THE LITERATURE)

Injection Treatment Only

Author	Solution	No of Cases	Cases Followed	Percentage of Recurrence	Time of Follow-Up	Emboli	Fatalities
Howard Jackson and Mahon [42] 1931	Sodium chloride 20%	66	52	98%	1 yr or more	1	0
Faxon [43] 1933	Quinine urethane	613	314	63%	Avg 1 4 yrs		
Kettel [44] 1932			225	86 6%	5 yrs		
Levi [45] 1927–28	Glucose 66%	60				1	0
Forestier [46] 1928				15%			
Frankel [47] 1929		800		8 to 10%		0	0
Logefield and Dahlstrom [48] 1929	Invert sugar sodium chloride	96		2%	6 mos		
Meisen,[49] 1927	Sodium chloride 10% and sodium salicylate 25%	500		0	9 mos		
Kilbourne [33] 1929	Various	Collected cases		6%			1 in 5000
Woolsey and Millzner,[50] 1929	Sodium salicylate 20% quinine and urethane	150		6%			
McPheeters and Rice [31] 1928			53 000 collected				7
Schmier [51] 1930	NaCl, Na salicylate, Quinine HCl and urethane dextrose	3,000				0	
Scott [52] 1930	Quinine and urethane	10,000				0	0
Cooperman [53] 1929	Sodium salicylate 40%	64		18%	3 to 5 mos		
Keller [54] 1929	Sodium chloride 20%	1				1	0
Hansen [55] 1931		107		49%	1 to 3 yrs		
Kettel,[56] 1931		60,000 collected				10	20 deaths from emboli and other causes
Mundt [57] 1930							1 death from mercury poisoning
Pennoyer [58] 1930	Sodium salicylate quinine urethane	218	48	8%	18 mos		
Silverman,[59] 1931	All	Review literature				In entire literature 19 Adds 1	In entire literature 14 Adds 1
Ochsner and Mahorner [5] 1937	Sodium morrhuate		25	57 2%	6 mos to 3½ yrs		

TABLE II

RESUMÉ OF STATISTICS RELATIVE TO MORTALITY, RESULTS AND RECURRENCES (COMPILED FROM THE LITERATURE)

Operative Treatment

Author	Method	No of Cases	Cases Followed	Percentage of Recurrence	Time of Follow Up	Emboli	Fatalities
Howard [3] 1934	Ligation and injection distal stump	68	58	23%	1 yr to 29 mos		
Colt [36] 1928	Keller Babcock	94	22	18%	4 to 6 yrs	0	0
Putzu [70] 1919	Schiassi	32	32	19%			0
Siebner [37] 1929	Multiple transfixions Schede	20	15	60%	6 mos to 2 yrs		
Keller [11] 1924	Extraction by inversion	33	33	0	1 yr		0
Tanner [38] 1927	Extraction by inversion Keller Babcock	52	29	18%	Avg 22 mos		0
deTakáts and Quilhan [4] 1933	Ambulatory ligation	200	60	3%		0	0
Muller [34] 1928	Simple ligation excision ligation and injection	100	51	46%	At least 9 mos	2	1 (1%)
Kilbourne [35] 1929	Various operations	14 000		30%			0 4%
Tavel [16] 1912	Ligation and injection	50	50	12%			0
Miller [33] 1906	Trendelenburg	98 legs	41	22%	6 mos to 10 yrs		
Miller [33] 1906	Schede	19 legs		66%	6 mos to 10 yrs		
Berntsen [9] 1927	Trendelenburg	83	83			8 4%	1 2%
Berntsen [9] 1927	Extirpation	376				7 2%	0 7%
McPheeters and Rice [31] 1928	Collected operations by various surgeons	6,771	6 771			72	35 (0 53%)
Faxon [9] 1934	Ligation and injection	118				1	1
Perthes [14] 1895	Ligation mostly in lower third of thigh	63	41	22%	5 mos to 9 yrs		
Ochsner and Mahorner [5] 1937	High ligation only plus injection	11	11	18%			
Ochsner and Mahorner [5] 1937	Ligation midthigh only	12	12	50%			
Bange [41] 1925	Ligation and multiple subcutaneous discissions	100					1

Tables I and II present a resume of the statistics relative to mortality, results, and recurrences compiled from the larger series of cases reported in the literature It will be noted in the report of authors upon series of cases treated by the injection method only, that the recurrence rate is reported from zero in nine months and 2 per cent in six months, to 98 per cent in cases followed for a longer period In our experience[5] the injection treatment

has been followed by recurrences in 60 per cent As far as the mortality is concerned, McPheeters and Rice's[31] figures of seven deaths in 53,000 collected cases is proof enough that the injection of sclerosing solutions for varicose veins is a relatively safe procedure The reported results from operative methods show recurrences from zero to 66 per cent Ligation combined with injection treatment showed recurrences as follows Tavel,[16] 12 per cent, Putzu,[20] 19 per cent, Howard,[32] 23 per cent, R Miller,[13] 22 per cent, and deTakats and Quillian,[4] 3 to 5 per cent Operative procedures other than those grouped as ligation alone, including excisions, gave recurrences as follows Muller,[34] 46 per cent, Kilbourne,[35] 30 per cent, Colt,[36] 18 per cent, Siebner,[37] 60 per cent, Keller,[11] none, Tanner,[38] 18 per cent, and R Miller,[33] 66 per cent As regards the mortality for operative procedures, Muller[34] reported 1 per cent mortality in 100 cases, Kilbourne,[35] 0 4 per cent mortality in 14,000 cases, and Berntsen,[9] 0 7 per cent mortality in 376 patients We have had no deaths in our experience in over 100 ligations with simultaneous or subsequent injection of sclerosing solutions, all of which were managed by ambulatory convalescence We have found no deaths reported after ligation and injection of sclerosing solutions when an ambulatory convalescence has been enforced On the other hand, Domanig[39] encountered pulmonary embolism twice, with one fatality, in 43 cases treated by ligation and section and injection of sclerosing solution into the distal lumen, when the patients were kept in bed for ten days

Although these statistics are very significant, they are not as conclusive in their directions as one would wish them The wide ranges of reports, if not confusing, at least weaken confidence in the following conclusions which express only in a general way the trend of the statistics, namely, operative treatments such as excision and ablation have a mortality of from 0 4 per cent to 1 per cent, which is far higher than the mortality by the injection treatment Simple ligation apparently has less risk, which has been shown by our experience, in which ambulation was enforced during convalescence, and by the absence of reports in the literature of deaths when ambulatory regimen was used Enforced walking during convalescence is a distinct advantage and reduces the danger of pulmonary embolism Any method which has from 0 5 to 1 per cent mortality for varicose veins must be looked upon with disfavor because of the remarkably low mortality following the injection treatment On the other hand, the trend of the statistics in recent series of varicose veins treated by injection alone shows an extremely high percentage of recurrences, far more undoubtedly than the incidence of recurrence from ligation and the use of sclerosing solutions

For these reasons, and our personal experiences, we have reached the following conclusions regarding operative measures with or without the injection treatment versus the injection treatment alone Procedures such as extirpation and enucleations with strippers or other instruments are too severe and extensive, necessitating the patient having a convalescence in bed, which predisposes to embolism, and a mortality too high to justify them em-

ployment Ligation combined with the injection treatment is a relatively simple and very safe procedure, and is followed by less frequent recurrence than the injection treatment alone, which is, apparently, quite safe We take the following attitudes in selecting the cases for these types of treatment

For the injection treatment alone we select

(1) Early cases with small varicose veins of the calf or lower leg, which, clinically, do not show a positive Trendelenburg-Brodie phenomenon, even if a recurrence follows, there has at least been a temporary benefit, and if it becomes necessary other measures may be employed later

(2) Those cases which are suitable for operative treatment and refuse ligation

(3) Certain cases where the psychologic approach to operation seems best accomplished by an initial and partial injection treatment In certain instances in studying the case it is surmised that if an operation is immediately advised the patient will not only refuse the operation but also any active treatment, because since the former, which she does not want at the moment, was presented first, everything else seems second best and the wary patient is frightened away from what might be the best procedure for her

For operative treatment with the combination of the injection of sclerosing solutions, we select all cases with moderate or severe varicosities in whom there are no contraindications to active treatment As far as the type of operative treatment is concerned we discard, as carrying too high a mortality and being too severe, the complete excision of the saphenous vein and its radicals (Madelung, the Mayo operation, and Keller and Babcock extractions) These radical procedures carry no more promise of permanence of results than ligations and transactions combined with the injection of sclerosing solutions Schede's operation is followed by many recurrences, so many in fact, that it is not worthy of serious consideration

(4) *Technic of Operative Treatment*—Our preference for the high ligation and transection of the internal saphenous vein, just before it enters the femoral vein, and above any of its tributaries, with the simultaneous injection of a sclerosing solution into the distal lumen, and in certain instances, as indicated by the comparative tourniquet test, additional ligations and injections below this level, has been stated

The technic of ligation of the saphenous vein high is as follows The patients need no special preliminary preparation, they do not have to fast The patient is placed in dorsal decubitus The inguinal and pubic region and adjacent upper part of the affected thigh is shaved The skin of this area is cleansed with ether and painted with some suitable antiseptic Draping the field is important A folded sterile towel is placed in the crotch, protecting the thigh from the genitalia and pubic region The surface sheets and towels are so spread that an operative field is left which exposes the middle and inner part of Poupart's ligament and the adjacent upper part of the thigh from a line outside the middle to the recessing inner border of the thigh It is important to have the field large enough to palpate the femoral artery, and to

have adequate room to work mesially because the course of the saphenous vein is sharply posterior from its termination at the saphenous opening The femoral artery is palpated as it passes under Poupart's ligament The fossa ovalis is located two fingerbreadths mesial to this and one fingerbreadth below Poupart's ligament, or below the level of the spine or pubis A longitudinal incision gives a better exposure than the transverse (Fig 6) With a longitudinal incision, the collateral channels at the upper end of the saphenous vein are exposed more easily and with less dissection The important tributaries are the external pudendal, the superficial circumflex iliac, the superficial epigastric, thoraco-epigastric, and the external superficial femoral vein (Fig 7) Anomalies of these vessels are very common They sometimes enter directly into the femoral vein, two or more of them sometimes forming a common stem before emptying into the saphenous vein It is very important to see the termination of the following tributaries The external pudendal, the external superficial femoral, and the external circumflex iliac The external pudendal should be above the area of injection of sclerosing solution into the long saphenous, because it is not desirable to have any of the solution go into veins of the labia majora or the scrotum, especially if these veins are not varicosed, and at the same time it is desirable to interrupt the flow in the external pudendal, particularly when it is varicosed, because collaterals from this vein into the internal superficial femoral veins are possible channels for reestablishment of a retrograde circulation and thereby predispose to a recurrence On the other hand, it is desirable to inject the sclerosing solution into the external superficial femoral vein, either by injecting it into the great saphenous vein above the termination of this trunk or into the separately ligated external superficial femoral vein It is rare, even in severe cases, for the internal saphenous vein to be visualized at its upper end, because it is so deep and is covered by fat and skin Even palpation may not localize it and Schwartz's test[29 40] is infrequently of value

The incision begins at Poupart's ligament and 2 5 cm mesial to the line of the femoral artery (Fig 6) The latter landmark is appreciated by palpating the pulsating artery as it passes under the middle of Poupart's ligament The incision continues for a distance of about 5 cm straight downward and slightly inward, diverging from the line of the artery The vein is deep in the subcutaneous tissue, of considerable thickness here especially in women One can incise through this without danger but should be cautious of injuring either the vein or its collaterals Suspicion of the proximity of the vein may be often inferred before the vein has been uncovered, by a peculiar darkness or blueness showing through the fat The vein is from 0 5 to 2 cm in diameter It is isolated and separated from surrounding tissue, to its entrance into the fossa ovalis and downward for about 3 5 cm The long saphenous vein is not easily confused with the femoral It is superficial to the deep fascia—that is, the very thick fascia lata—and if there is any doubt it is well to remember that the femoral artery is lateral and contiguous to the

femoral vein One will note the external pudendal vein emptying into the saphenous vein from the medial aspect, and the superficial circumflex iliac and the external superficial femoral usually a little higher from the lateral aspect (Fig 7) The latter veins frequently enter directly into the femoral vein These may be transacted and ligated separately or if the external superficial femoral is low enough the saphenous vein may be doubly clamped, transected, and ligated above it The long saphenous vein is clamped near its termination with two small curved hemostats, between which the vein is transected The proximal stump is then transfixed with No 2 silk or with No 1 plain catgut, and ligated securely on one side and then by rotating the clamp the ends are

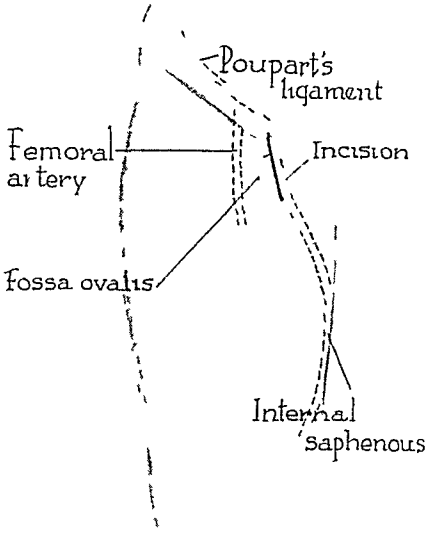


Fig 6 —Location of the incision for high ligation of the saphenous vein Two finger breadths mesial to the pulsating femoral artery, and beginning just below Poupart s ligament it runs downward and slightly inward

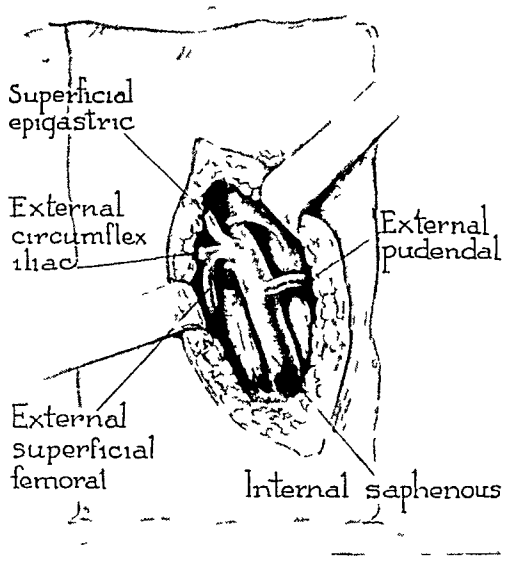


Fig 7 —Anatomy at upper end of the internal saphenous vein showing important tributaries which should be ligated separately In this instance drawn from the patient shown in Figs 2 and 4, the superficial epigastric external circumflex iliac and superficial femoral veins enter by a common stem at the junction of saphenous with the femoral vein but they all may enter separately either at this level or higher or lower These veins and the external pudendal shown should always be ligated and sectioned to obviate recurrences in the collaterals

brought around the vein and tied again The vein stump is then ligated again, without transfixing, proximal to the first transfixed ligature on the theoretic grounds that no suture material is exposed in the lumen after secondary ligation, in order not to initiate a thrombus in the free circulation Otherwise, the transfixing suture may still be exposed to the current of venous blood going directly to the heart With a small Sana-lok syringe, 2 or 3 cc of 5 per cent sodium morrhuate (Searle's) or 5 per cent sodium gynocardate are then injected into the distal lumen of the transected vein (Fig 8) Care must be taken to keep the sclerosing solution from leaking from the vein into the field of operation This upper end of the distal segment is transfixed and doubly ligated A thrombus in the segment is desirable The ends of the cut vein retract several centimeters from each other when released

The subcutaneous tissue is approximated with No 2 silk and the skin sutured with dermal

The patient remains on the table one hour and is then permitted to go home in an automobile, walking to the elevator and car She is advised to rest for the first few days but not to remain in bed entirely We insist that she get out of bed and walk around the room every two hours even on the day the operation is performed She wears a compression "Ace" bandage or an elastic stocking during this period, and after 48 hours, if there is not too much dis-

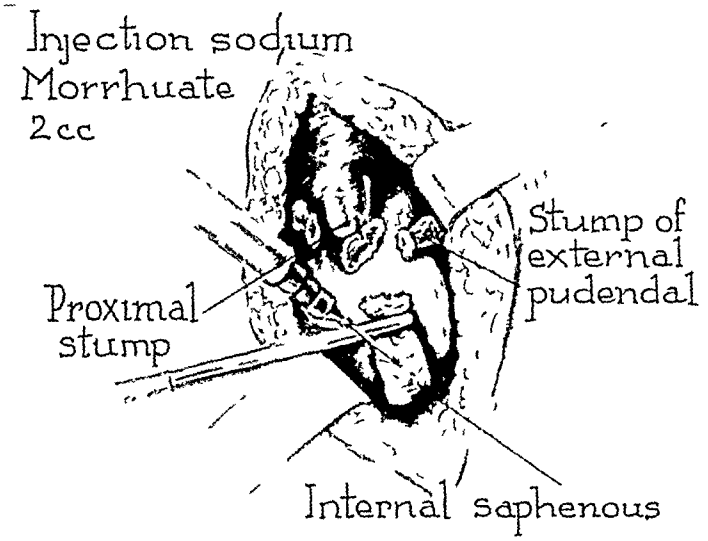


FIG 8.—After section and ligation of the proximal stump of the internal saphenous vein and its tributaries 2 cc of 5 per cent sodium morrhuate are injected into the distal segment The vein is clamped below this level, transfixed, and ligated

comfort, the individual is usually fully able to tend to duties Patients must be reasonable and not stand on their feet for eight hours a day during the first few days after treatment Frequently a hard palpable vein, which obviously contains a thrombus, can be felt before the patient leaves the table In approximately 90 per cent of the cases, a thrombus will be found after 48 hours, extending from the operative site to just above the knee in the internal saphenous vein, and in approximately 40 or 50 per cent of instances the thrombus will extend downward into the varicosed radicals of the calf Not infrequently, however, there will be small ectatic veins on the calf which need to be injected individually ten days or two weeks after the operation

This completes the treatment in those cases which have incompetence only of the valves of the great saphenous vein, but for that group in which the comparative tourniquet test has also shown that valves of the communicating veins are incompetent something more is advisable in order to interrupt this retrograde flow through the veins communicating between the deep and the superficial systems of the thigh When a retrograde flow or leak from the deep to the superficial system is occurring below the main opening of the saphenous vein, the communicating veins, which are responsible in this instance, are usually in the thigh, and generally it is not through the communi-

cating veins of the calf or from the popliteal vein through the main opening of the external saphenous into the external saphenous system If there is a direct retrograde flow from the popliteal vein into the external saphenous system, it is advisable to interrupt this retrograde flow by a separate ligation of the external saphenous vein at the upper end There are several possible ways of stopping the leaks through the communicating veins These are (1) Ligation of each communicating vein individually, (2) extirpation of the internal saphenous and ligation of communicating veins and collaterals, and (3) ligation and transection of the saphenous below the level of all the communicating veins with incompetent valves

It is not feasible to ligate each communicating vein individually, because it would necessitate exposing the entire length of the internal saphenous vein in the thigh and ligating and sectioning each tributary Such an operation would become, therefore, a major procedure of as much magnitude as extirpation of the internal saphenous vein by the Madelung method When a thrombus forms in the internal saphenous vein, which we have described as occurring in the majority of cases after distal injection of sclerosing solution, there is less retrograde flow through this vein from incompetent communicating channels There is, however, a tendency for this obstruction to disappear, especially when the blood in the venous system is under high pressure The most feasible remaining procedure, therefore, seems to be an additional transection and ligation of the saphenous vein below all the communicating veins which have incompetent valves This is done some two weeks after the high ligation of the saphenous on the same side and again 2 cc of sodium morrhuate are injected into the distal stem of the vein Apparently it is more important here to resect a sleeve of the saphenous about 2 cm in length because of the danger of recurrence through the scar

It is to be recognized, in employing this procedure, that recurrences can take place around the site of ligation through the collateral channels in the superficial system of veins and also that recurrences can take place through the scar While appreciating this, it is also to be remembered that no method of treating varicose veins insures definitely against recurrence It seems that the method detailed above will give better permanent results than any of the other methods

Furthermore, no matter what the treatment is for varicose veins, no attempt is made to reestablish the normal physiology, nor can this be accomplished In the injection treatment alone, obstruction to the flow is produced by initiating thrombosis in the vessel With ligation and injection a more definite obstruction is brought about Excision attempts to remove the pathologic vessels, but it does not reestablish normal physiology

In those cases which show recurrences the patients must be treated, again selecting the method most applicable to the conditions which they present at the time they apply for treatment of the varicosities To forestall any concern the patient may have relative to recurrences, they are told that there is no way of predicting in which patients varicosities will again occur, but that there is

such a tendency, and that at least 10 per cent will recur after such treatment They are assured that varicosities can be corrected again, and that if they never neglect varicose veins they will not develop complications such as ulcer and hemorrhage

REFERENCES

[1] Mahorner, H R, and Ochsner, A A New Test for Evaluating Circulation in the Venous System of the Lower Extremity Affected by Varicosities Arch Surg, 33, 479, 1936

[2] Brodie, Sir Benjamin Lectures Illustrative of Various Subjects in Pathology and Surgery London, Longman, *et al*, 1846

[3] Trendelenburg, F Ueber die Unterbindung der Vena saphena magna bei Unterschenkelvaricen Beitr z klin Chir, 7, 195, 1891

[4] deTakats, G, and Quilhan, L Ligation of the Saphenous Vein Arch Surg, 26, 72, 1933

[5] Ochsner, A, and Mahorner, H R The Modern Treatment of Varicose Veins Surgery (in press)

[6] Moro, G Ueber die Pathogenese und die zweckmassigste Behandlung der Krampfadern der unteren Extremitaten Beitr z klin Chir, 71, 420, 1910

[7] Schede, Max Ueber die operative Behandlung der Unterschenkelvaricen Berl klin Wchnschr, 14, 85, 1877

[8] Madelung Ueber die Ausschalung cirsoider Varicen an dem unteren Extremitaten Verhandlung der Deutsch Gesellsch f Chir, 13, 114, 1884

[9] Berntsen, A Varices of the Lower Limb, Especially from the Point of View of Etiology and Surgical Treatment Acta chir Scand, 62, 61, 1927

[10] Keller, W L A New Method of Extirpating the Internal Saphenous and Similar Veins in Varicose Condition New York Med, 82, 385, 1905

[11] Idem Combined Extirpation and Obliteration in Treatment of Varicose Veins Annals of Surgery, 79, 907, 1924

[12] Mayo, C H Treatment of Varicose Veins Surg, Gynec, and Obstet, 2, 385, 1906

[13] Babcock, W G A New Operation for the Extirpation of Varicose Veins of the Leg J A M A, 86, 153, 1907

[14] Perthes, Georg Ueber die operation der Unterschenkelvaricen nach Trendelenburg Deutsch med Wchnschr, 1, 253, 1895

[15] Tavel, E Behandlung der Varicen durch die Ligatur und die kunstliche Thrombose Correspondenzbl f Schweizer Aerzte, 34, 617, 1904

[16] Idem Die Behandlung der Varicen durch die kunstliche Thombose Deutsch Ztschr f Chir, 116, 735, 1912

[17] Schiassi, B La cure des varices du membre inferieur par l'injection intraveineuse d'une solution d'iode Semaine Med, 28, 601, 1908

[18] Mazzini, O F Treatment of Varicose Veins with Particular Reference to Schiassi's Method Semana Med, 2, 807, 1926

[19] Foa, G The Excellence of the Italian Method in the Treatment of Varicosities of the Lower Limb Gazz Internat Med Chir, 33, 66, 1928

[20] Putzu, F La cura delle varici degli arti inferiori col metodo Schiassi Clin chir Milano, 26, 1163, 1919

[21] Schiassi, B Modern Italian Treatment of Venous Varicosities Atti d Soc lomb di sc, med e biol, 17, 169, 1928

[22] Nobile, U Treatment of Varicose Veins in Leg by Schiassi's Method Policlinico, 28, 149, 1921

[23] Unger, E Zur Technik der Varicenbehandlung Zentralbl f Chir, 54, 3273, 1927

[24] Friedel, G Operative Behandlung der Varicen, Elephantiasis und Ulcus cruris Arch f klin Chir, 86, 143, 1908

[25] Meyer, F Die Behandlung des varikosen Symptomenkomplexes nach Rindfleisch-Friedel und deren Erfolge Beitr z klin Chir, 89, 276, 1914
[26] Meyer, F Zur Varizenbehandlung insbesondere nach Rindfleisch Deutsche med Wchnschr, 50, 1410, 1924
[27] Homans, J The Operative Treatment of Varicose Veins and Ulcers Based on a Classification of These Lesions Surg, Gynec, and Obstet, 23, 143, 1916
[28] deTakats, G Ambulation Ligation of the Saphenous Vein J A M A, 94, 1194, 1930
[29] Faxon, H H Treatment of Varicosities Arch Surg, 29, 794, 1934
[30] Hanschell, H M Personal Communication to Kilbourne Annals of Surgery, 93, 691, 1931
[31] McPheeters, H O, and Rice, C O Varicose Veins, Complications, Direct and Associated, Following Injection Treatment, Review of the Literature J A M A, 91, 1090, 1928
[32] Howard, N J Ambulatory Treatment of Varicose State by Combined Ligation and Thrombosis by Injection Arch Surg, 29, 481, 1934
[33] Miller, R The Results of Operative Treatment of Varicose Veins of the Leg by the Methods of Trendelenburg and Schede Bull Johns Hopkins Hosp, 17, 289, 1906
[34] Muller, J Ueber Varicenbehandlung und ihre Embolliegefahr Beitr z klin Chir, 144, 424, 1928
[35] Kilbourne, W J Treatment of Varicose Veins of the Legs J A M A, 92, 1320, 1929
[36] Colt, G H Modern Treatment of Varicose Veins, History of Its Evolution Brit Med Jour, 2, 525, 1928
[3] Siebner, M Erfahrungen mit Varicenbehandlung, insbesondere mit der perkutanen Umstechung nach Schede-Kocher Deutsche Ztschr f Chir, 215, 115, 1929
[38] Tanner, E K, and Field, W H Operative Treatment of Varicose Veins Surg Clin N Amer, 7, 1103, 1927
[39] Domanig, E Zur aussprache uber Vorteile Nachteile und Gefahren der Injektionsbehandlung der Varicen Zentralbl f Chir, 57, 935, 1930
[40] Hesse, E Ueber ein palpatorische Symptom der Kloppeninsufficienz bei beginnendun und nicht sichtbaren varicen Beitr z klin Chir, 85, 591, 1913
[41] Bange, F Erfahrunger mit den Klapp'schen Diszisionen bei Kramfadern Zentralbl f Chir, 52, 2696, 1925
[42] Howard, N J, Jackson, C R, and Mahon, E J Recurrence of Varicose Veins Following Injection A Study of the Pathologic Nature of the Recurrence and a Critical Survey of the Injection Method Arch Surg, 29, 481, 1934
[43] Faxon, H H End-results in the Injection Treatment of Varicose Veins New England Jour Med, 208, 357, 1933
[44] Kettel, K Cited by Howard [35] Beitr z klin Chir, 154, 585, 1932
[45] Levi, D The Treatment of Varicose Veins by Injection Proc Roy Soc Med, 1, 1830, 1927–1928
[46] Forestier, Jacques Varices of Lower Limbs J A M A, 90, 1932, 1928
[47] Frankel, W K Wird die Embolliegefahr nach kleinen Eingriffen an den Varicen durch hohe Unterbindung der Saphena verringert oder vergrossert? Der Chir, 11, 527, 1929
[48] Logefield, R C, and Dahlstrom, A W Sclerosing Treatment of Varicose Veins by Chemical Irritants Am Jour Med Sci, 177, 690, 1929
[49] Meisen, V Injection Treatment and Its Sequelae Ugesk f Laeger, 89, 47, 1927
[50] Woolsey, J H, and Millzner, R J Varicose Veins, Their Clinical Obliteration Calif and West Med, 30, 325, 1929
[51] Schmier, A A Sclerosing Injections in Varices of the Lower Extremities J A M A, 94, 1222, 1930
[52] Scott, Noel The Treatment of Varicose Veins by Injection Brit Med Jour, 2, 58, 1930

[53] Cooperman Injection Treatment of Varicose Veins Med Jour and Rec, 129, 541, 1929
[54] Keller Discussion of Paper by Auschutz, W and Lohr, W Zur Eroffnung einer Aussprache uber Vorteile, Nachteile und Gefahren der Injektionsbehandlung der Varicen Zentralbl f Chir, 2, 3211, 1929
[55] Hansen, S Cited by Howard [54] Arch f klin Chir, 1931
[56] Kettel, K Ueber Todesfalle im Auschluss an die Injektionsbehandlung von Varicen Zentralbl f Chir, 58, 1498, 1931
[57] Mundt, R C Injection for Varicose Veins with Fatal Outcome Clin Med and Surg, 37, 361, 1930
[58] Pennoyer, G P Injection Treatment of Varicose Veins ANNALS OF SURGERY, 91, 416, 1930
[59] Silverman, I Incidence of Embolism in Treatment of Varicose Veins with Sclerosing Solutions, Report of Fatality JAMA, 97, 177, 1931

DISCUSSION.—DR WM D HAGGARD (Nashville, Tenn.).—After this perfect exposition and compelling confirmation, I believe that it is like carrying sugar to New Orleans to add anything. This definite demonstration of what has been happening to us without our knowledge is going to be extremely helpful. Like many of you, I have gone through with all the forms of treatment. We began with circumcision of the veins through the skin (Schede's operation), with ligation of the severed superficial veins with only fair results. Then we employed the extensive vein stripping operation, which was fairly satisfactory. The demonstrations of Doctor Mahorner convince us that our source of error was that we ligated the long saphenous vein too low. In addition to ligation of the vein at the saphenofemoral junction, ligation of the tributary veins is necessary, particularly the superficial epigastric, the circumflex iliac, and the external pudendal vein. The immediate grade injection of sodium morrhuate, and then a few subsequent injections below the knee is curative in practically all cases. If one fails to ligate those veins one is likely to have recurrence. We are all familiar with the disappointing results, by and large, of injection of sclerosing solutions above. I think most surgeons now feel that this simple procedure of ligating not only the long saphenous but those three tributaries, offers the best results. We have used it in a number of cases that have recurred after vein injections, vein stripping and ligation of the saphenous below the junction.

THE REPAIR OF SURFACE DEFECTS OF THE HAND*

JAMES BARRETT BROWN, M D
ST LOUIS, MO

FROM THE DEPARTMENT OF SURGERY WASHINGTON UNIVERSITY SCHOOL OF MEDICINE ST LOUIS MO

AN ATTEMPT will be made here to illustrate the representative problems that have occurred in a rather large group of surface deformities of the hand A definite finding has been that free skin grafts have given satisfactory results in a high percentage of patients and in many where the use of a pedicled flap might have been thought necessary The application of free grafts may require more time at one operation, but the total amount of work may be much less If the free graft does not give a satisfactory result, then it can be replaced with a flap, but this has not been found necessary in this series

Where deeper work is going to be necessary—such as nerve, tendon, bone or joint repair or if these structures are too much exposed—then a pedicle flap containing some subcutaneous fat may be desirable

A simple, fundamental rule can be deduced That when the full-thickness of the skin has been lost, even over small areas, in such a kinetic region as the hand, the indication for treatment is to restore this loss as completely and as soon as possible

One note of warning should be made of the frequent recommendations for certain methods of treatment that "do not leave scars" This is a fallacy if there has been a full-thickness loss, and carrying out the plan of waiting for some application to produce healing has resulted in permanently crippled hands Frequently, along with this plan, the thumb has been dressed right alongside the index finger with disregard of the position of function

The repair of tendons and nerves is considered a separate phase in reconstructive surgery of the hand, and one naturally follows the advice of the most consistent workers in this field—extensive reports of which have been made by Kanavel, Koch and Mason

Fresh Superficial Burns—A fresh burn of the hand can probably best be managed by open surgical drainage, using wet packs or grease gauze, rather

* In the 1919 edition of Da Costa's Surgery, there is an illustration of a full-thickness skin graft which was accomplished by Dr George Summers Brown, a former surgeon of Birmingham, Ala, and by Dr J M Mason, for the correction of a burn deformity of the hand The result of this operation, performed some time before 1910, is excellent, and better than many obtained to-day in single operations for such lesions As Doctor Brown was a member of the Southern Surgical Association, perhaps nothing could have made him happier than to be present at this Anniversary Meeting, and it is in his memory that I would like to present the following communication

than sealing the area as with tannic acid or plaster of paris. The open method allows early determination of the depth of the loss and movement of the joints, and, if there has been no full-thickness loss of skin, early healing and return to function can usually be obtained by simple debridement of the dead surface and keeping the hand clean and comfortable. If infection does develop in this type of wound, or if the hand is neglected and left out of the



FIG. 1.—(A) Laundry burn with full thickness loss of skin of entire dorsum of thumb grafted after two weeks. (B) Complete permanent coverage with thick split graft, after seven months.

position of function, a marked crippling may result from deep fixation of tendons and joints, and possibly from loss of the skin itself from infection.

Fresh Deep Burns.—A full-thickness loss over the back of the thumb that was sustained in a laundry-press is shown in Fig. 1. The wound was gently debrided, and open drainage with wet dressings started. At the end of two weeks the area was covered with a thick, split-skin graft and complete function without deformity has resulted. (Patient cared for by Dr. Gene Bricker, Resident Surgeon at Barnes Hospital.) Another laundry-press loss is shown in Fig. 2, when seen one month after the accident. Gentle debridement (which includes soap and water cleansing and the removal of dead skin), and salt

packs were used, in five days the granulations were carefully cut away, and the entire defect covered with a split-skin graft from the thigh This patient has been recorded before but is again reported here, after four years, to show that there has been complete and permanent function

Late Unhealed Burns—If losses have been very widespread, there may be repeated ulceration and permanent healing may never occur The plan of restoration in patients with open wounds is to graft these areas first so the region will be clean when the hand is opened for correcting the deformity

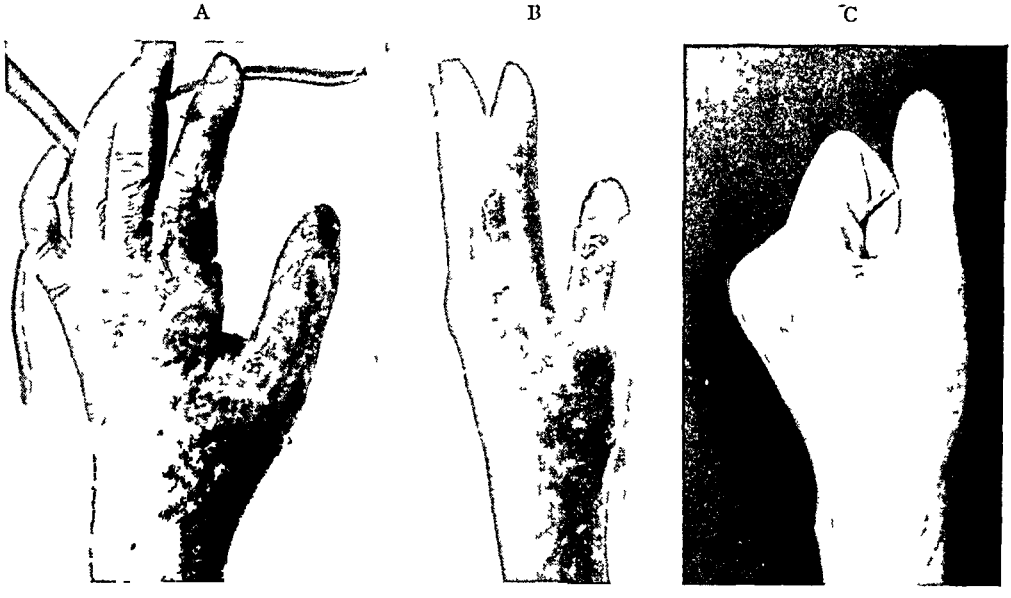


FIG 2—(A) One month after laundry mangle injury and burn (B) Two days later, after gentle debridement and saline dressings Operation performed three days later at which the granulations were carefully cut away down to a firm base and the entire area was covered with a single large thick split graft (C) Complete and permanent function shown after four years

This type of unhealed lesion after 14 months with complete loss of use of the left hand is illustrated in Fig 3 The contracture has drawn the thumb out of the position of function, caused a deformity of the joint surface and dislocation of the metacarpophalangeal joint After the arms were healed with split-skin grafts, then the contracture was carefully opened so the thumb could be put in fairly good position, and the resulting defects were filled with split-grafts A second releasing operation was necessary, and a direct circumferential wire was put around the metacarpal to hold it out in position while the grafts were becoming fixed The result is shown in Fig 3 *B* with the thumb and fingers functioning for the first time since the accident

Late Deformities Repaired with Free, Thick Split-Grafts—Many late deformities can be repaired by carefully dissecting the scar so that complete correction can be obtained with little or no tendon exposure, and then covering the defects with thick split-grafts The patient shown in Fig 4 is chosen to represent this because of the extensiveness and occurrence of contractures in both hands

The split-graft is cut one-half to three-fourths the thickness of the skin

deep—if possible, in a single piece large enough to cover the entire area It is sewed on at about normal skin tension with running horsehair sutures all around, usually with the graft overlapping the wound edge, and basted through



FIG 3.—(A) Left hand completely out of position of function 18 months after a deep burn, with the arm still not healed (B) Fairly normal position restored by three split graft operations, with thumb and fingers functioning for the first time since the burn

the center after multiple stab holes are made in the graft for drainage (The general details of splinting and dressing are described later under full-thickness grafts)



FIG 4.—(A) Widespread deep burns of the dorsum of both hands, corrected by careful dissection of the scar without damage to the tendons and covering each area with one large split graft (B) and (C) Shows complete permanent function three years later

If ulcerated areas such as roentgen ray burns and the arm in Fig 3 are grafted, the first dressing is the same except that the gauze next to the graft is wet with saline and is kept wet with irrigating tubes incorporated in the dressing, for four days This plan of wet dressing is open to question, but,



FIG 5 —See legend on opposite page

for the present, it seems to be the safest for the success of the graft, in most contaminated areas

The split-graft is rough at first, the fine silk ligatures may work through to the surface, and have to be removed (Fig 10 *D*), and many sebaceous collections may have to be emptied by pressure or small incisions However, the grafts usually clear up so that in six to eight months they cannot be distinguished from a full-thickness graft or even normal skin in some instances (Fig 2)

Partial Restoration of Function—In some patients the deformities are so bad that complete function can never be expected These result from excessive widespread surface loss, deep losses of tendons and dislocation of joints from primary or secondary contractures Many of these deformities might be prevented by adopting the view that the lost skin should be replaced early, and there probably can never be any excuse for the completely webbed, or degloved hand as it has been called

One of these patients is shown in Fig 5 *A* and *B* who could not even dress himself The thumb, fingers, and wrist were all out of position of function and the situation seemed almost hopeless, but in four operations the scars have gradually been removed, and the surface covered with thick split-grafts, so that the thumb is fairly well around and the wrist is up (Fig 5, *C* and *D*) This result is not complete function, but the patient is able to get around normally and some of his work in occupational therapy is illustrated in Fig 5 *E* He is also able to draw and hopes to enter art school His left hand was even worse than the right and was repaired in the same way

Healed Deformities Repaired with Free Full-Thickness Grafts—*Dorsal surface loss* can in many instances be successfully replaced with thick split-grafts (Fig 4) Although there seems to be no actual measure of advantage of final function of the full-thickness graft, it is often relied upon, however, where widespread clean dissection and removal of the binding scar can be accomplished

The patient in Fig 6 *A* has complete loss of the use of the hand, with thumb and wrist entirely out of the position of function, and the fingers so held back that metacarpophalangeal dislocations and joint deformities will occur This is the result of a widespread surface loss, but the depth of scar cannot be determined until the dissection of it has progressed In this instance, complete function and movement were restored with a single free full-thickness graft from the abdomen put on at one operation, and covering the entire area (Fig 6 *B*) At operation the scar is very carefully dissected from the underlying tendons, rough, forceful flexion of the wrist (or any other joint area

Fig 5—(A) and (B) Complete loss of use of hand one year after severe burns which have destroyed all the skin and many of the tendons and joints Patient unable to dress himself (C) and (D) After several operations of a rather slow progress in removing the scar skin and replacing it with split grafts Appearance not good but patient able to draw well enough to enter art school and do work as shown in (E) (E) Part of many objects made as a result of instruction by occupational therapists

that is being opened) will tear the scar overlying tendons and cause undesirable exposure of the tendons themselves The scar is removed in layers if necessary, and, with cross-cuts in small areas to allow stretching, and the contracted tendons have to be gradually pulled out so that complete flexion can be obtained if possible It is even advisable to leave a thin layer of scar on the tendons rather than expose them, if a free graft is to be used, because the graft will not grow on a large area of exposed tendons When all relaxation



FIG 6—(A) Complete extension deformity following a widespread full thickness loss of skin, with thumb and fingers definitely out of position of function (B) Full restoration of function after careful dissection and coverage with a single full thickness graft Shown after two years to indicate the permanence of the result There is complete flexion of the wrist and all carpal joints (C) Method of fastening hand to wire (or solid aluminum splint) with sterile adhesive and of application of the graft (three hours operative time) (D) Three weeks after operation full take of graft arm being taken off splint (E) Abdominal defect healed by direct suture

possible has been obtained, the hand is fastened to the wire mesh splint as illustrated, or to an aluminum splint prepared ahead of time, using sterile adhesive The splint is bent to throw the wrist and fingers as far out of the former contracted position as possible and an accurate pattern of the defect is

cut A full-thickness graft is then sutured all around the edges and up on the fingers (Fig 6 *C*) The hand is shown in Fig 6 *D* after three weeks' time with a full-take of the graft, it is now ready to be removed from the splint, and function can be started

If the defect will not open completely at the first attempt because of tendons that are too tight or for fear of exposing too much of them on forced manipu-

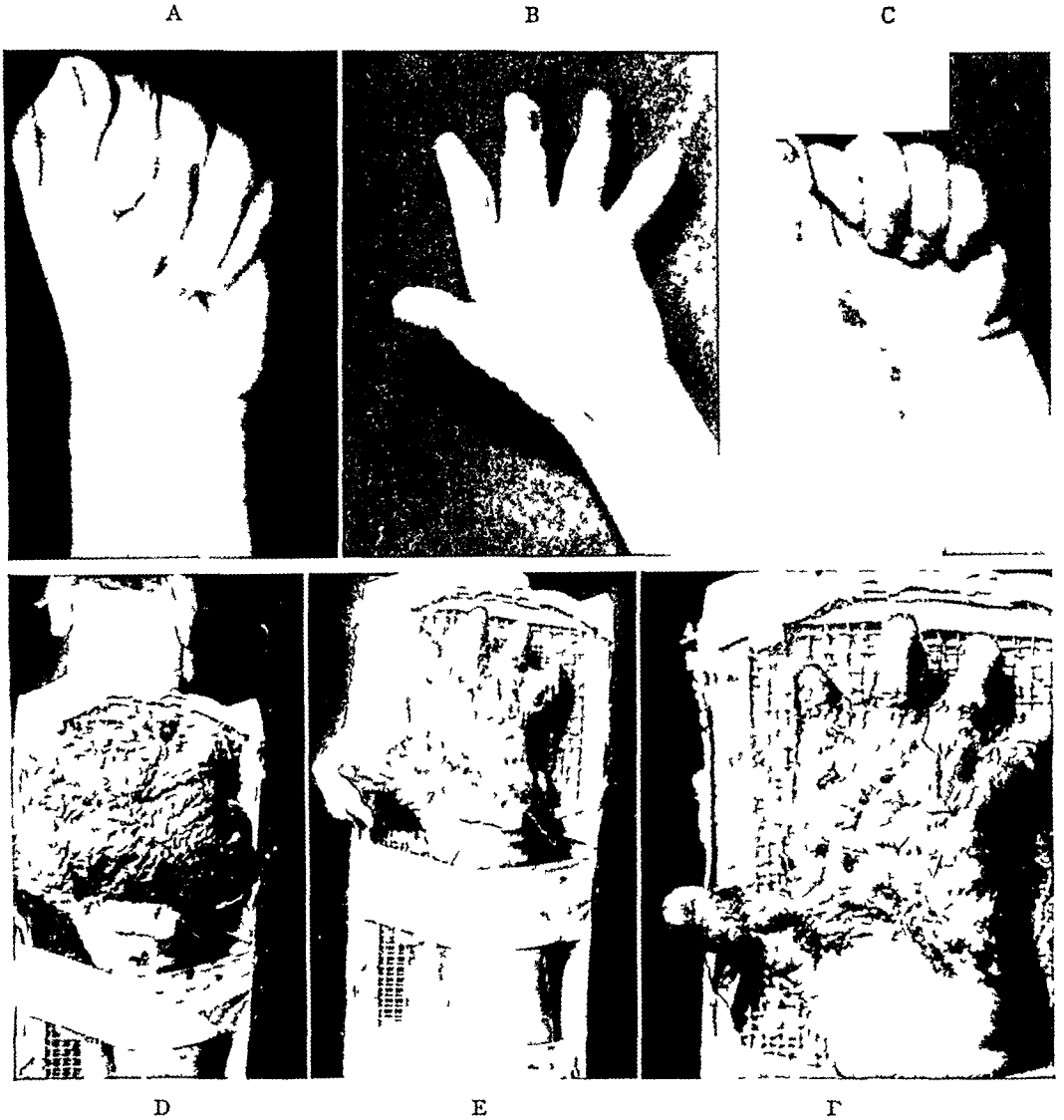


Fig 7.—(A) Complete flexion deformity and webbing of the fingers several years after a burn (B) and (C) Full function obtained with one full thickness graft and two subsequent procedures to relieve the webbing (D) Hand shown at time of first dressing with molded marine sponge in place Dorsal surface well padded (E) Fine mesh, grease gauze next to the graft which is dry indicating full take of the graft (F) Full take shown with edge sutures, individual mattress sutures through the surface, stab holes through the graft, and fingers held extended with silver wires through each tip and held to the wire splint

lation, then whatever areas are open are grafted, and further freeing and grafting is done subsequently (Figs 3 and 5) If tendons are lost and have to be replaced, or if they are too much exposed, then the advisability of using a thicker pedicle flap must be considered (Figs 13 and 14)

Tunnel grafts have been reported as giving satisfactory results, especially

along the dorsal surfaces of the fingers, but they have not been employed in this group of patients

Palmar surface losses can nearly always be repaired with free grafts Deep losses along the fingers may require thicker flap repair, but full function in one of these is seldom obtained The contracted single finger, especially in a child, that shows keloid formation, with its probable deep inflammation, may be one of the hardest deformities to repair, and careful consideration should always be given this apparently simple lesion

The hand in Fig 7 *A* has a complete flexion deformity and webbing of the fingers Restoration was obtained with one full-thickness graft and two subsequent operations for the release of the webs (Fig 7 *B* and *C*) The first dressing is shown in Fig 7 *D*, *E* and *F* The fingers have been held with silver transfixion wires around the terminal phalanges and fastened to the wire splint The wire is used instead of tape when the graft comes so far out on the fingers A pad of gauze separates the dorsal surface from the wire splint, and, over the knuckles, a thin rubber sponge may be used

The question of late function of a free graft in the palm might well arise, and, in the answer, the anatomy may be considered The skin and subcutaneous tissues of the palm are different than elsewhere, for normal function, the thenar pad is essential, the thumb must be as strong as the fingers and normal position and movements of the fingers are essential When this area is resurfaced, the skin necessarily must come from another part of the body and it always retains its original characteristics and does not change into the type of skin of the sound palm The grafts shown here in Figs 7 to 10 have stood up under the patient's requirements, but, if any work proves to be too strenuous, there is little that can be done other than have the patient wear a glove for protection In this instance, substituting a pedicle flap would seldom be of benefit because the difference of the skin surface would be the same as the free graft

Details of the Full-Thickness Graft—The 14 year old contracture, shown in Fig 8 *A*, gave promise of a fairly good correction because there had been preservation of joint movement and tendon activity The lengthening of these tendons by traction is not certain until the area is opened, but, for a successful correction in one operation, it is necessary that the entire deformity be opened and the hand maintained in complete correction during the period of healing of the graft This point is almost as important when a pedicle flap is being employed and will be referred to later in Fig 13

Preparation of Bed for Graft—Fig 8 *B* shows the freeing obtained by removal of the small, transverse, heavy scars and then careful dissection backward of the palmar flaps without damage of the nerves or complete exposure of the tendons The edges of the defect are not straight lines but have "darts" in them to allow maximum replacement of skin If a straight, narrow graft is put in a child's finger, a possible keloid along the edge may produce deformity The palmar flaps are utilized in making new interdigital spaces and for part of the finger coverage, and then patterns of the defects are cut in thin sheet



FIG 8—(A) Flexion deformity of 14 years standing (B) Careful opening without damage to nerves or tendons careful hemostasis fingers can be straightened (C) The interdigital spaces have been made out of the contracted palmar skin Lead patterns have been cut of all three defects (D) The graft is sewed accurately all around the edges of the separate defects and mattress sutures are put through the surface if necessary (E) Result three months later Patient satisfied with function which is apparently normal (F) The patterns have been traced and outlined through the skin of the inner part of the thigh (G) and (H) The full thickness of the skin is raised with as little damage as possible using fine forceps and gauze for holding No fat is taken up on the graft (I) The graft is free and the resultant wound can be sutured or covered with a split graft from an adjacent area

lead (Fig 8 *C*) Careful hemostasis is done with pressure and ligatures of white No triple o silk *

Cutting the Graft—The patterns are outlined on the inner side of the thigh and an incision is made just through the skin (Fig 8 *F*) Elevation of the full-thickness of the skin is then accomplished, using small forceps or gauze traction on the graft and some countertraction on the edges of the donor area to prevent any subcutaneous fat from adhering to the graft Some small particles may persist which may be removed with scissors later—if these would retain their viability, they would be of great advantage (Fig 8 *G* and *H*) The resultant defect of the donor area can now be closed directly or, if too large, can be covered rapidly with a split-skin graft from an adjacent area (Fig 8 *I*)

Application of Graft—The hand is fastened to a wire or aluminum splint with sterile adhesive, with the fingers extended, and can then be handled much more easily The graft is sewed accurately into place all around the edges, in order to favor obtaining primary union, where edges are too loose to allow a normal stretch of the graft, reefing sutures may be taken to pull the edges back away from the defect The tension with which the graft is sewed on—that is, from side-to-side—is best described as normal skin tension, *i e*, not pulled tightly like a drum-head, or left so loose that it may wrinkle (Fig 8 *D*) If the graft is larger, then it is held down to the bed with additional mattress sutures through the surface (Fig 7 *F*)

Dressing the Graft—A few drainage holes are put through the graft and one layer of fine mesh, greased gauze (5 per cent scarlet red, xeroform or zinc oxide) is placed, very smoothly, next to the graft Over this one or two gauze flats are placed and cotton or soft marine sponge is packed carefully between the fingers Over this a soft, bleached, "wool-form" sea sponge is placed and bandaged firmly in place A board splint is added for stability and the ends of the fingers are left visible Fig 7 *D*, *E* and *F* show a hand at the time of the first dressing, done eight days after operation There is a full-take of the graft with no sign of infection, but dressings must be maintained for two weeks longer, using wet applications if inflammation should occur—otherwise continuing with the greased gauze The sutures can be removed at the first or later dressings, and there may be an apparent delay in healing because so much of the surrounding, heavily keratinized skin comes away

The splint is usually maintained for three weeks and then movements are gradually restored This long fixation, which is primarily for the graft, helps the tendon lengthening also, but it does not do joint movement any good If there is tendency for contraction after this period, the patient is usually allowed to go about his activities during the day, and at night the dorsal splint

* All possible skin is saved and utilized in making these repairs, and flaps may be shifted some distance, but the so-called Z-plastic, in which scar webs and bands are entirely depended on to obtain relaxation, and function has not been relied on in any patient in this series

is reapplied, using either an aluminum one or a simple one made of wood and held on with adhesive

Persistence of Function and Growth of a Free Skin Graft over a Nine-Year Period—An important indication to the use of free grafts in general, in children, is illustrated by the patient shown in Fig 9 *A*, who had a complete flexion deformity of the hand, of one year's duration This was entirely corrected in one operation, with a single full-thickness graft covering the

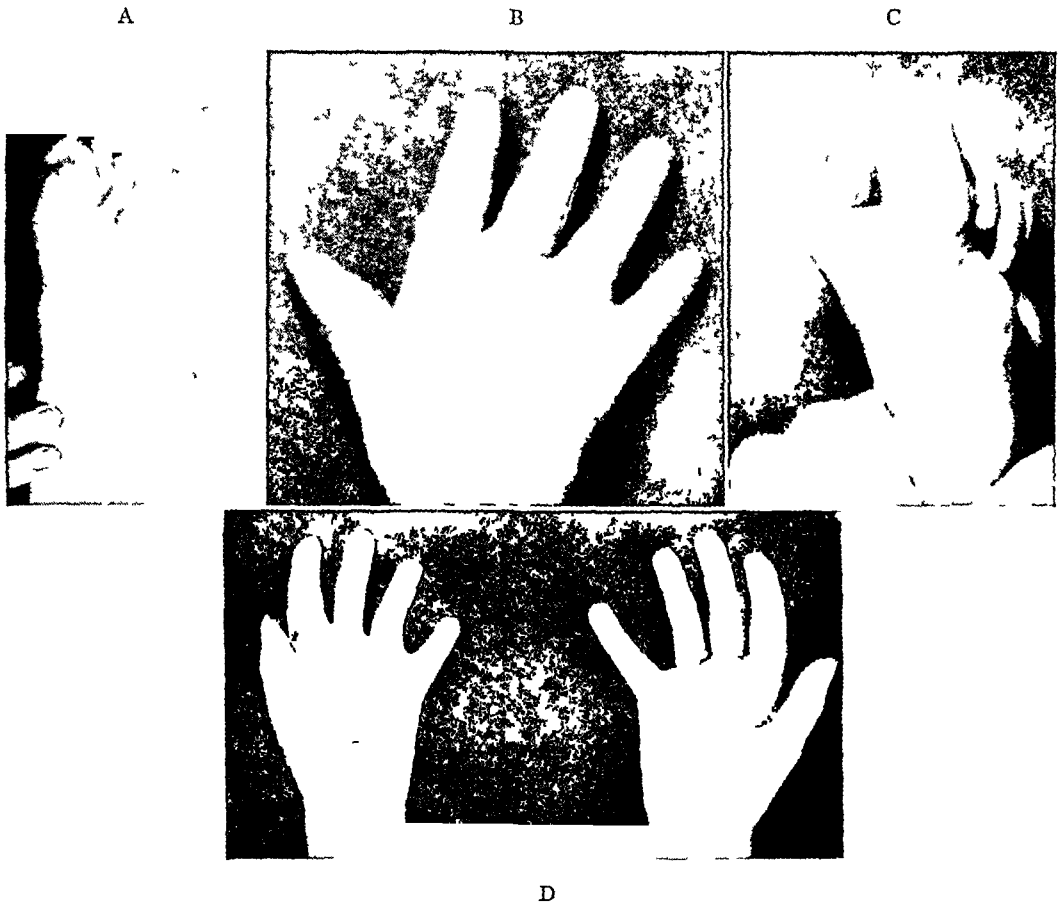


Fig 9.—(A) Complete flexion deformity of one year's duration (B) and (C) Full function obtained by careful opening of the hand and covering with a full thickness graft Shown here one year later after removal of a slight webbing (D) Shows same hand after nine years with about same relative size as compared with the other hand having been preserved Patient completely satisfied and not desirous of any further operative procedure

palm and palmar surfaces of the fingers and thumb—three and one-half hours' operative time—(Fig 9 *B* and *C*) The same hand is shown nine years later in Fig 9 *D*, with full function being retained, and the boy satisfied and able to play baseball The comparison in size with the right hand is about the same as when originally seen, the hand having about kept pace with the normal one, but not having picked up what was lost during the year of deformity If there should be a lag in growth, dependent upon the graft, more skin could be put in at any time

Roentgen Ray Burns—In repairing roentgen ray burns wide excision and immediate grafting with thick split-skin grafts will give the most consistently

good results If ulceration is present, or if there is bone or tendon exposed in the fingers, amputations may have to be performed, or a pocket-flap from the thigh or abdomen resorted to, but, with the promise of success by early

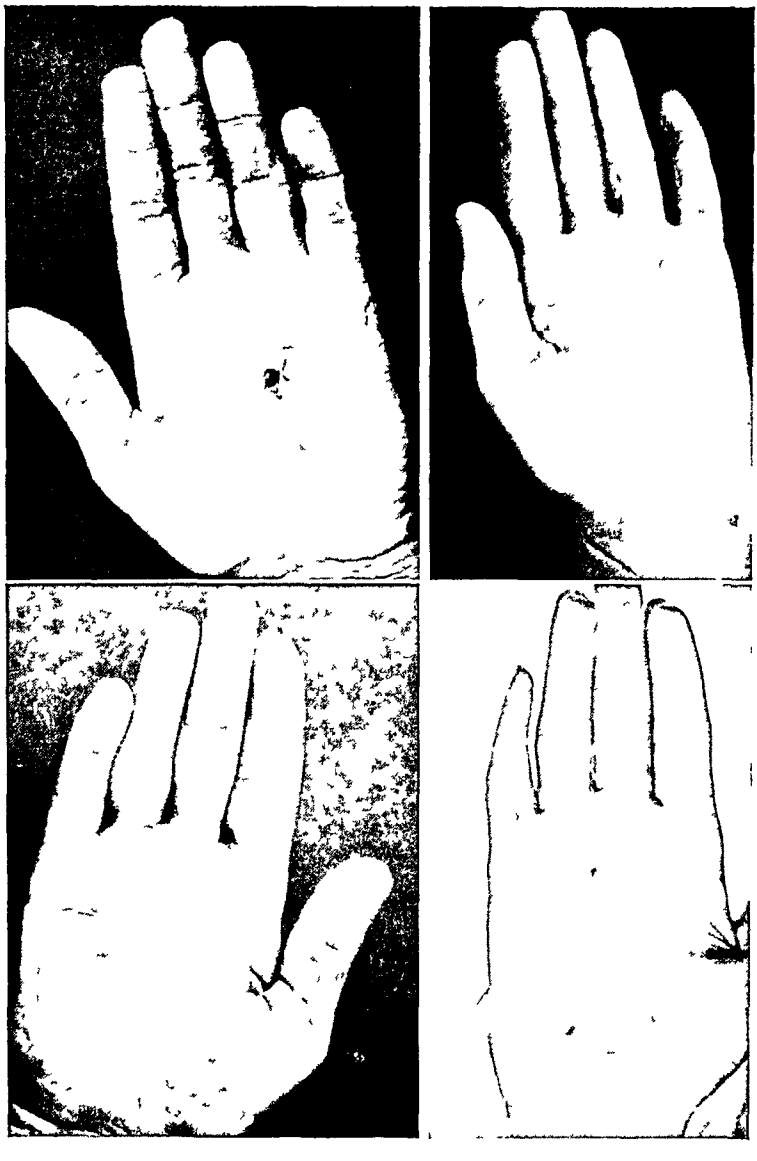


FIG 10.—(A) and (C) Roentgen ray burns of entire palmar surfaces of both hands with ulceration in the left that requires immediate removal (B) and (D) Split graft restorations in left hand after three years in the right after three months Normal function and sensation present in the left and anticipated in the right

widespread free-skin grafting, most patients should fall short of this degree of neglect

There have been so many failures with immediate free-grafting of roentgen ray burns that many surgeons prefer to excise the lesion first and then later graft a fresh granulating bed There is, also, serious argument against im-

mediate grafting or application of flaps in any patient with a history of repeated infection or evidence of deep inflammation about the area These areas should probably all be excised first, and repaired later, to avoid, as far as possible, serious crippling infection

The patient in Fig 10 *A* and *C* had widespread burns of both palms with ulceration in the left one The first problem was to get rid of the changing area and repair it as well as possible These areas are prepared with repeated soap and water cleansings and wet dressings for four days, and then widely and deeply excised without contamination of the deep area with the surface ulceration The defect is covered with a single thick split-graft and a continuous wet pressure dressing maintained for four days The area is then carefully nursed along until healed, and, in this patient, the final result is shown to be satisfactory with normal function persisting after three years (Fig 10 *B*) The rest of the palmar skin will eventually have to be replaced, but at this time the entire palm of the opposite hand is removed and replaced with a single thick, split-graft in one operation (Fig 10 *C* and *D*)

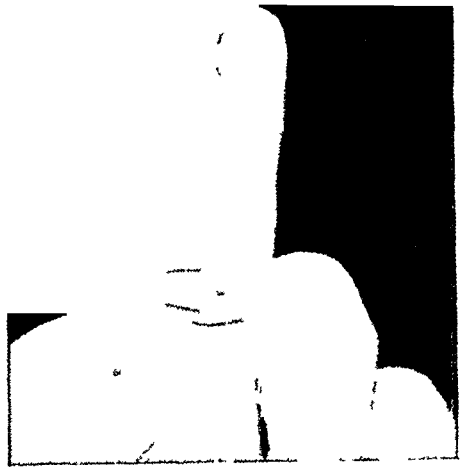


Fig 11.—Complete restoration of tip of finger including entire nail, eponychium and pad, by immediate resuture after it had been completely amputated and detached by a bread cutting machine

This procedure greatly simplifies matters for the patient, if successful, and eliminates the use of flaps in many instances If the graft is lost, the patient is not far behind the two-stage procedure of later grafting, except that he has one more donor area to heal In using split-grafts correctly this should practically never happen The full-take of an immediate free full-thickness graft on a roentgen ray burn area is so questionable that they are seldom employed

Complete Amputation of Finger Tips.—This subject is mentioned because of much conjecture regarding it, many misstatements of success and because one authentic success can be reported The finger shown in Fig 11 is the result of suture of the entire tip after it had been completely severed by a circular bread knife and had dropped down in the box The loss was oblique from below the nail, and the amputated piece contained the entire nail and pad and possibly a very small piece of bone The tip was put back on and about one hour later, the wound was inspected and the tip was again replaced, and this time accurately sutured There was a complete take of the graft, with a rather slow course because of the heavy keratinized layer coming away, and, of course, the entire nail There was, however, complete regeneration of the nail and its eponychium so that it appears normal Dr S L Koch saw the patient and suggested the possibility of grafting nails in this manner, but so far a patient with a good enough toe-nail to be placed on a finger has not been encountered (Free-grafts of nails and part of their beds have not

been successful enough to report here) It is thought that where there has been a clean amputation of a finger tip, immediate suture should be performed if possible Crushing losses are not so likely to give good results, and immediate free-grafts can be utilized or a pad supplied later by a simple flap from the palm

Web Fingers—This lesion is mentioned because congenital cases never seem to have enough skin in the webs to give satisfactory covering of the sides of the fingers if normal flaps are put between the fingers This interdigital flap is turned as a square U from the dorsal surface—as dorsal skin normally exists between the fingers—and is placed into an inverted T incision on the palmar surface Then any flaps available are used on the sides, but there will practically always be defects that cannot be closed without

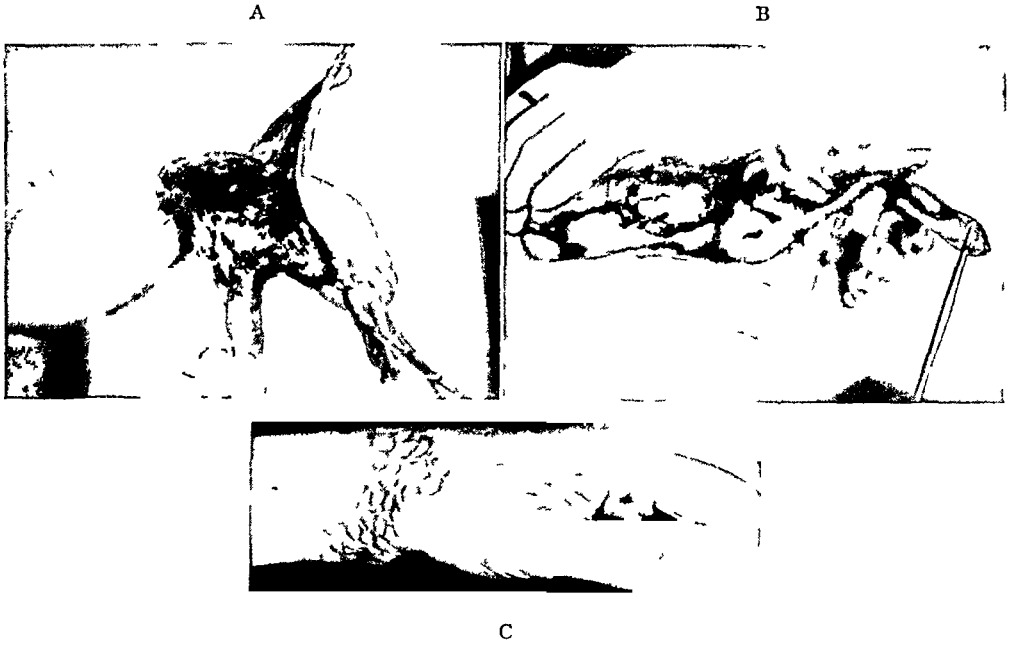


FIG 12—(A) and (B) Very wide flap torn by electric wringer with base distal (C) Result of flap suture and loss and subsequent closure of wound with small deep grafts

tension, and one premise of working with all defects in the hand is that they should be closed Thick split-grafts are, therefore, sewed in place between the fingers and light sponge pressure dressings applied

Two sides of one finger are never operated upon at the same time, so that in this patient two operations were necessary This is the advice of Dr Allen Kanavel, and the author has seen the loss of the ends of three fingers where this advice had not been followed

Wringer and Other Laundry Machine Injuries—Fairly frequent injuries are seen from catching the hand in electric wringers, and there is usually a large flap torn away with its base distal, there is seldom any tendon or bone damage, and, in a child, the tear may not occur until the arm has come between the rollers

Many of these cases can be repaired by immediate resuture, and, if it is

possible to determine that viability of part of the flap is lost, this can be trimmed away and an immediate free-graft applied The patient shown in

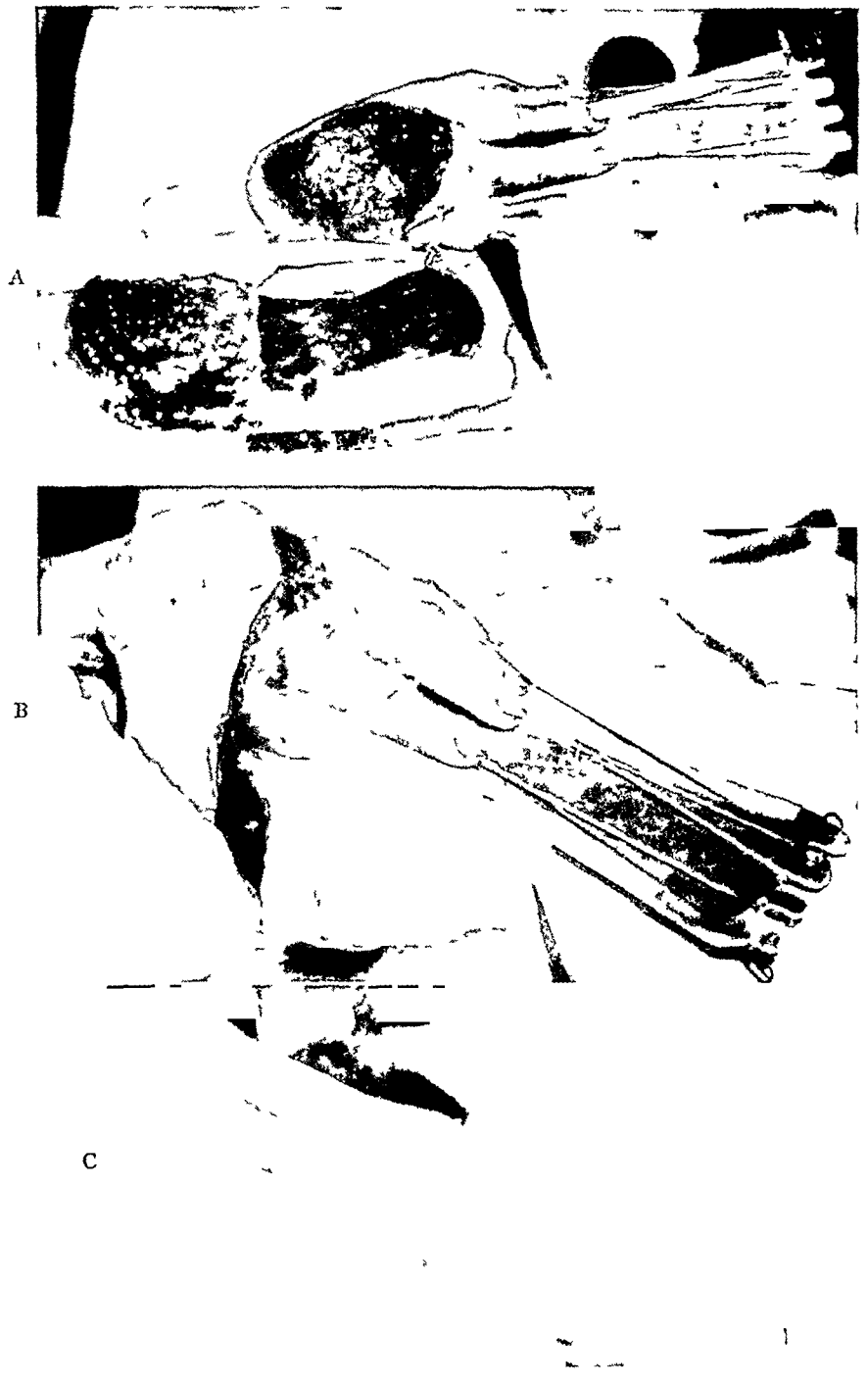


FIG 13—(A) and (B) Shotgun wound of hand with repair by a direct pedicle flap from the abdomen Hand splinted to give traction for the fingers and thumb rotated Same splint used after hand is detached to obtain joint motion and maintain traction A small wound of entry on the palmar surface was left to close itself (C) Result is a hand that is far superior to any prosthesis that might be devised

Fig 12 had a very large flap torn loose, and, because of poor physical condition, a chance was taken in replacing all of it There was loss around the

wrist, and healing has been hurried with small deep grafts applied without anesthesia

Other laundry injuries are shown in Figs 1 and 2 Some have tendon, joint or bone damage, so that pedicle-flap repairs become necessary

Pedicle-Flap Repairs of the Hand—There are definite indications for the use of thick pedicle flaps in hand repairs, such as Deep roentgen ray burns of the dorsum, gunshot wounds, any deep wound that exposes too much tendon, bone or joint, or any late repair that will subsequently need work on tendon or bone and which could not be accomplished with just a free-graft restoration of the surface A broad or double pedicle can nearly always be arranged so that the flap does not have to be delayed

Probably as many pitfalls occur in the use of flaps as in free-grafts, and patients are frequently seen with inadequate flaps, bunched up in a pad on the hand, only replacing part of the deformity

One of the necessary uses of a flap is illustrated in Fig 13 *A* The hand was placed right over a shotgun muzzle, and a small wound of entry was present on the palm, but with the huge excavation shown on the dorsum Amputation had been considered, but it was suggested that at least an attempt might be made to save the hand Accordingly, after eight days of cleaning the area, a direct flap from the right lower quadrant was sewed in place Important points, shown in Fig 13 *A* and *B*, are that the hand is on a splint from the start—even carrying it across the abdomen The fingers are held extended by simple rubber traction from holes in the finger nails to simple notches on the end of the splint This same traction was maintained during the entire period of attachment of four weeks, otherwise, there would have been retraction of the fingers the distance of the loss of the metacarpals, and also marked bunching up of the flap Another important point is that a cut-out has been made on the splint to allow rotation of the thumb This splint can be employed after operation to gain freedom of the joints, by simply bending the splint with the hand on it The result (Fig 13 *C*) is a hand that is useful in all housework, far superior to any artificial one, and superior to any possible result that could have been obtained with a free skin graft

The patient shown in Fig 14 *A* had a contraction of the hand and wrist from an infection that had bound the tendons so tightly that there was no movement At operation a wide dissection of the scar was effected, and the wrist let down, with so much exposure of deep structures that a direct abdominal flap from the opposite lower quadrant was put in place The abdominal wall itself is used as a splint in this instance with the wrist and hand flexed around it as comfortably as possible (Fig 14 *D*) The final result with the wrist flexed is shown in Fig 14 *B* and *C*, but without much flexion in the metacarpophalangeal joints The remaining wide, raw area over the abdomen is covered with split-grafts, as this seems better than drawing the area together or letting it heal itself

Occupational and Physical Therapy—Following surface repairs in which there has been no deep involvement, if a good result can be obtained and the

patient is fairly interested in his recovery, very little else need be done about his rehabilitation Children usually work out their own problems but, if much joint stiffness has developed, considerable difficulty may be experienced in getting it out of the metacarpophalangeal joints, and especially in women who are not likely to need this joint completely flexed Simple work in the home with the early use of rubber sponge exercise in closing the hand, and

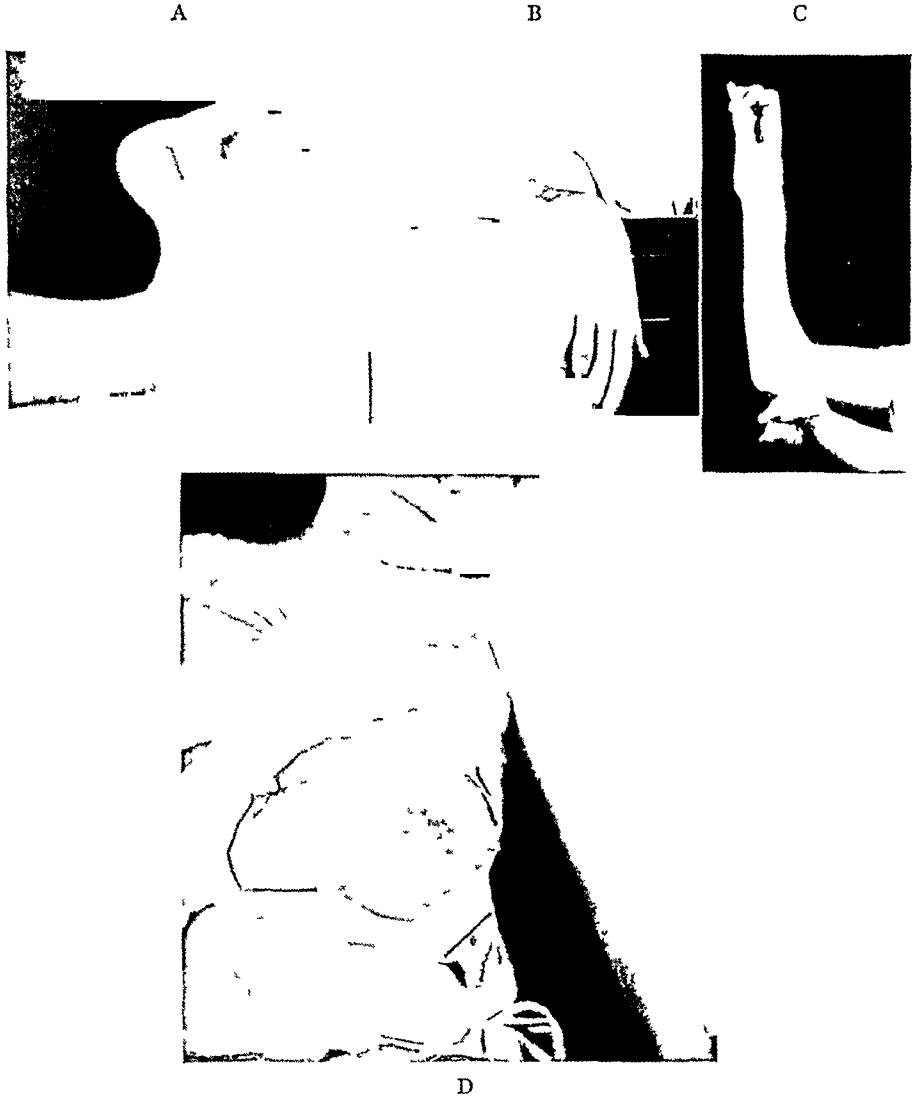


FIG 14.—(A) Extension deformity of fingers and wrist following a wide skin loss and tendon damage from infection (B) and (C) Voluntary flexion of wrist, but not much flexion of metacarpophalangeal joints obtained However, the hand in general almost normal in function (D) Hand splinted across abdomen, with flexion maintained and direct abdominal flap growing in place

such grosser movements as sweeping, shoveling, *etc*, may quickly loosen the joints Manipulation to swing thumbs around into place may be done frequently, but forced manipulation of these joints rarely produces anything but more stiffness Elastic traction and rotation of the thumb as illustrated in Fig 13, and as advocated by Kanavel, Koch and Mason for rehabilitation in deeper repairs, will produce the quickest freeing of joint fixation The finer movements of the interossei and lumbricals can be greatly stimulated by occu-

pational therapy, and many excellent results may be obtained Secondary operative procedures on the metacarpophalangeal joints may occasionally be of benefit and very badly dislocated phalangeal joints may be resected or an attempt at arthroplasty instituted, but the indications for this last procedure are very infrequent

DISCUSSION —DR J M T FINNEY, SR (Baltimore, Md) —In substantiation of what Doctor Brown has said about severed members and their replacement, I should like to report a personal experience Many years ago a young man came to the Johns Hopkins Hospital Dispensary with the ends of two fingers—the ring and middle fingers—cut squarely off by a chopping machine He was a tin cutter by trade The middle finger had been severed just below the last joint, leaving a small disk of the terminal phalanx, the ring finger, just at the base of the nail He said the accident had occurred over five hours previously

The cut surfaces looked clean, the bleeding had stopped I asked what *had become of the severed ends of the fingers He put his hand in his pocket* and pulled out a piece of newspaper, from which he produced the missing finger ends They looked clean, so I soaked them and the stumps of the fingers for at least an hour in warm salt solution I then took a sharp knife and carefully scraped both cut surfaces of each finger, and carefully replaced them One stitch of fine silk was taken in each of the four cardinal points I then held the fragments in close and accurate apposition by narrow strips of crepe tissue over the end, extending up the finger on both sides, held in place by collodion, which splinted the fragments perfectly The fingers were then put up together on a splint Perfect healing per primam was obtained, without any infection, in each finger I followed the patient for some years afterwards, at the end of which time use and sensation were perfect

I want to congratulate Doctor Brown on his excellent paper and his splendid results The history of the development of plastic surgery is a most interesting one The results to-day, compared with those of 50 years ago, are extraordinarily satisfactory

DR ELLIS FISCHEL (St Louis, Mo) did not think that one should lose sight of the fact that many years of patient trial and error were involved in the evolution of the meticulous technic recited by Doctor Brown He also felt that very few would have the patience to undertake the essential details, not only of the operation but also of the dressings, that were necessary However, there are some simple things a general surgeon can do to repair defects in the hands which he himself creates In carcinoma of the back of the hand, which does not involve the tendon sheaths, and which occurs usually in elderly people, it is not necessary to employ irradiation by either roentgen ray or radium It is easy to excise a lesion the size of a silver dollar, or even larger, under infiltration anesthesia, and immediately repair the defect by a skin graft Healing occurs in about ten days' time

A similar but more difficult procedure can be employed to repair the defect caused by excision of a carcinoma arising in old roentgen ray burns In these cases not only the tumor but all the neighboring scar tissue should be excised, and the resultant soft tissue defect should be repaired immediately by the method so ably illustrated by Doctor Brown, namely, by suturing a split- or full-thickness graft into the defect A careful pressure dressing is essential to the success of this procedure, which gives eminently satisfactory results with a minimum of time for after-care

DR JOHN STAIGE DAVIS (Baltimore, Md) said he would like to congratulate Doctor Brown on the splendid work he had shown today He had been interested in whole-thickness skin grafting for a long time, in fact, the first paper he ever wrote was on the relief of scar contractures by the use of whole-thickness grafts These grafts should be employed more than they are, but unless one is familiar with the technic and has had experience in handling these grafts, he will not get as good results as have been shown in this very unusual presentation of Doctor Brown's

THE INFLUENCE OF PREOPERATIVE MEDICATION ON POSTOPERATIVE COMPLICATIONS

A STATISTICAL STUDY

E VERNON MASTIN, M D

ST LOUIS, MO

FROM THE DEPARTMENT OF SURGERY ST LUKE'S HOSPITAL AND THE ST LOUIS UNIVERSITY SCHOOL OF MEDICINE ST LOUIS MO

THIS paper is based upon a review of the records of 9,592 operations that were performed at St Luke's Hospital, between the years 1921 and 1936 All of the cases that are included in this review received some derivative of opium combined with either atropine, hyoscine, or one of the barbiturates preoperatively Since dilauded, pantapon and codeine were used in less than 100 cases, they have been considered together under the general heading of morphine There were 6,591 cases that received morphine and atropine, 2,613 that received morphine and hyoscine, and 388 that received morphine and one of the barbiturates Tabulations have been prepared which show the complications which occurred after each type of preoperative medication

All of the usual postoperative complications were recorded, but only two stood out conspicuously, namely, catheterization, and the subsequent development of cystitis and pyelitis as manifested by pus in the urine On account of this finding, no genito-urinary cases were included in this study No definite relationship was found between the anesthetic and the number or type of the complication

TABLE I

492 CASES OF THYROIDECTOMY

(*Mortality-Rate 3 2 per cent*)

	Morphine-Atropine	Morphine-Hyoscine	Morphine-Barbital
No of cases	275	140	77
No catheterized	6	4	1
Percentage catheterized	2 2%	2 8%	1 3%
Cystitis-pyelitis	0	1	0
Percentage cystitis-pyelitis	0	0 7%	0
Pneumonia	6	5	2
Acute crises	8	5	1
Deaths	7	7	2
Total complications	20	14	2
Percentage of complications	7 2%	10 %	5 2%

Table I shows an analysis of 492 thyroidectomies Of these 275 received morphine-atropine preoperatively, 140 morphine-hyoscine, and 77 morphine-

barbital In the morphine-atropine group, 2 2 per cent were catheterized, in the morphine-hyoscine group, 2 8 per cent, and in the morphine-barbital group, 1 3 per cent In the morphine-atropine group, 7 2 per cent of the patients developed some form of complication, 10 per cent in the morphine-hyoscine group and 5 2 per cent in the morphine-barbital group

TABLE II

410 CASES OF BREAST AMPUTATION

(Mortality-Rate 1 5 per cent)

	Morphine-Atropine	Morphine-Hyoscine	Morphine Barbital
No of cases	328	58	24
No catheterized	15	7	2
Percentage catheterized	4 6%	12 2%	8 3%
Cystitis-pyelitis	3	2	0
Percentage cystitis-pyelitis	0 9%	3 4%	0
Pulmonary infarct	2	0	0
Shock-hemorrhage	1	0	0
Pneumonia	1	0	0
General carcinoma	3	1	0
Deaths	5	1	0
Total complications	22	8	2
Percentage of complications	6 7%	13 8%	8 3%

Table II shows an analysis of 410 breast amputations 328 received morphine-atropine preoperatively, 58 morphine-hyoscine, and 24 morphine-barbital Four point six per cent were catheterized in the morphine-atropine group, 12 2 per cent in the morphine-hyoscine group, and 8 3 per cent in the morphine-barbital group There were 0 9 per cent in the morphine-atropine group that developed cystitis or pyelitis, 3 4 per cent in the morphine-hyoscine group, and none in the morphine-barbital group In the morphine-atropine group, 6 7 per cent developed some form of complication, 13 8 per cent in the morphine-hyoscine group, and 8 3 per cent in the morphine-barbital group

Table III shows an analysis of 789 herniotomies 664 received morphine-atropine, 97 morphine-hyoscine, and 28 morphine-barbital Ten point eight per cent were catheterized in the morphine-atropine group, 21 6 per cent in the morphine-hyoscine group, and 3 6 per cent in the morphine-barbital group There were 1 2 per cent in the morphine-atropine group that developed cystitis or pyelitis, 5 2 per cent in the morphine-hyoscine group, and none in the morphine-barbital group In the morphine-atropine group, 13 per cent developed some form of complication, 29 9 per cent in the morphine-hyoscine group, and 10 7 per cent in the morphine-barbital group

TABLE III

789 OPERATIONS UPON HERNIAE

(*Mortality Rate 1 5 per cent*)

	Morphine Atropine	Morphine Hyoscine	Morphine-Barbital
No of cases	664	97	28
No catheterized	72	21	1
Percentage catheterized	10 8%	21 6%	3 6%
Cystitis-pyelitis	8	5	0
Percentage cystitis-pyelitis	1 2%	5 2%	0
Pneumonia	8	2	1
Bronchitis	0	2	0
Pleurisy	3	2	0
Peritonitis	2	0	0
Pulmonary embolus	5	1	0
P O hemorrhage	2	0	0
Intestinal obstruction	0	1	0
Myocarditis	1	0	0
Deaths	10	2	1
Total complications	93	29	3
Percentage of complications	13 %	29 9%	10 7%

TABLE IV

4,173 CASES OF APPENDICECTOMY

(*Mortality-Rate 1 9 per cent*)

	Morphine-Atropine	Morphine-Hyoscine	Morphine-Barbital
No of cases	3,057	1,036	100
No catheterized	452	299	15
Percentage catheterized	14 7%	22 1%	15%
Cystitis-pyelitis	53	56	2
Percentage cystitis-pyelitis	1 7%	5 4%	2%
Peritonitis	39	10	0
Pulmonary embolus	11	6	0
Pneumonia	18	11	1
P O hemorrhage	4	0	0
Pleurisy	0	8	0
Phlebitis	20	8	0
Bronchitis	0	6	1
P O shock	2	0	0
Intestinal obstruction	3	2	0
Typhoid fever	1	1	0
Deaths	59	20	1
Total complications	566	279	18
Percentage of complications	18 7%	27 %	18%

Table IV shows an analysis of 4,173 appendicectomies 3,057 received morphine-atropine, 1,036 morphine-hyoscine, and 100 morphine-barbital Fourteen point seven per cent were catheterized in the morphine-atropine group, 22 1 per cent in the morphine-hyoscine group, and 15 per cent in the morphine-barbital group There were 1 7 per cent in the morphine-atropine group that developed cystitis or pyelitis, 5 4 per cent in the morphine-hyoscine group, and 2 per cent in the morphine-barbital group In the morphine-atropine group, 18 7 per cent developed some form of complication, 27 per cent in the morphine-hyoscine group, and 18 per cent in the morphine-barbital group

TABLE V

1,083 OPERATIONS UPON THE GALLBLADDER

(Mortality-Rate 5 7 per cent)

	Morphine-Atropine	Morphine-Hyoscine	Morphine-Barbital
No of cases	796	243	44
No catheterized	132	53	5
Percentage catheterized	16 6%	21 8%	11 4%
Cystitis-pyelitis	21	16	0
Percentage cystitis-pyelitis	2 6%	6 6%	0
Peritonitis	9	3	0
P O hemorrhage	14	7	0
Pneumonia	24	5	0
Bronchitis	0	3	0
Pleurisy	2	1	0
Pulmonary embolus	5	1	1
Phlebitis	3	3	0
Liver shock	2	0	0
Myocarditis	5	0	0
Intestinal obstruction	4	0	0
Deaths	48	13	1
Total complications	195	76	6
Percentage of complications	24 5%	31 3%	13 6%

Table V shows an analysis of 1,083 gallbladder operations 796 received morphine-atropine, 243 morphine-hyoscine, and 44 morphine-barbital Sixteen point six per cent were catheterized in the morphine-atropine group, 21 8 per cent in the morphine-hyoscine group, and 11 4 per cent in the morphine-barbital group There were 2 6 per cent in the morphine-atropine group that developed cystitis or pyelitis, 6 6 per cent in the morphine-hyoscine group, and none in the morphine-barbital group In the morphine-atropine group, 24 5 per cent developed some form of complication, 31 3 per cent in the morphine-hyoscine group, and 13 6 per cent in the morphine-barbital group

Table VI shows an analysis of 666 gastro-intestinal operations stomach, small intestines and colon Four hundred eighty-eight received morphine-atropine, 140 morphine-hyoscine, and 38 morphine-barbital Twelve point

five per cent were catheterized in the morphine-atropine group, 26 4 per cent in the morphine-hyoscine group, and 10 3 per cent in the morphine-barbital group There were 4 per cent in the morphine-atropine group that developed cystitis or pyelitis, 4 3 per cent in the morphine-hyoscine group, and none in the morphine-barbital group In the morphine-atropine group, 25 5 per cent developed some form of complication, 37 8 per cent in the morphine-hyoscine group, and 21 per cent in the morphine-barbital group

TABLE VI

666 OPERATIONS UPON THE GASTRO-INTESTINAL TRACT

(Mortality-Rate 18 7 per cent)

	Morphine-Atropine	Morphine-Hyoscine	Morphine-Barbital
No of cases	488	140	38
No catheterized	61	37	4
Percentage catheterized	12 5%	26 4%	10 3%
Cystitis pyelitis	20	6	0
Percentage cystitis-pyelitis	4 %	4 3%	0
Pulmonary embolus	5	0	0
Pneumonia	21	8	1
Bronchitis	4	0	1
Pleurisy	1	0	0
Peritonitis	17	3	1
Intestinal obstruction	8	3	0
P O shock	6	0	0
Phlebitis	1	0	1
Cardiac failure	0	2	0
General carcinoma	45	16	3
Deaths	92	29	4
Total complications	124	52	8
Percentage of complications	25 5%	37 8%	21 %

Table VII shows an analysis of 963 operations upon the uterus and the adnexa Five hundred fifty-nine received morphine-atropine, 372 morphine-hyoscine, and 32 morphine-barbital Twenty-one point eight per cent were catheterized in the morphine-atropine group, 54 per cent in the morphine-hyoscine group, and 13 6 per cent in the morphine-barbital group There were 3 4 per cent in the morphine-atropine group that developed cystitis or pyelitis, 17 2 per cent in the morphine-hyoscine group, and 3 1 per cent in the morphine-barbital group In the morphine-atropine group, 25 5 per cent developed some form of complication, 58 3 per cent in the morphine-hyoscine group, and 15 6 per cent in the morphine-barbital group

Table VIII shows an analysis of 1,016 abdominal hysterectomies Four hundred forty-four received morphine-atropine, 527 morphine-hyoscine, and 45 morphine-barbital Thirty point six per cent were catheterized in the morphine-atropine group, 57 2 per cent in the morphine-hyoscine group, and 20 per cent in the morphine-barbital group There were 6 8 per cent in the morphine-atropine group that developed cystitis or pyelitis, 33 6 per cent

in the morphine-hyoscine group, and 4 per cent in the morphine-barbital group In the morphine-atropine group, 37 per cent developed some form of complication, 62 4 per cent in the morphine-hyoscine group and 22 2 per cent in the morphine-barbital group

TABLE VII

963 OPERATIONS UPON THE UTERUS AND ADNEXA

(Mortality-Rate 1 9 per cent)

	Morphine-Atropine	Morphine-Hyoscine	Morphine-Barbital
No of cases	559	372	32
No catheterized	122	201	5
Percentage catheterized	21 8%	54 %	13 6%
Cystitis-pyelitis	19	64	1
Percentage cystitis-pyelitis	3 4%	17 2%	3 1%
Pulmonary embolus	1	2	0
Pneumonia	2	4	0
P O hemorrhage	3	1	0
Peritonitis	6	1	0
Pyelonephritis	1	0	0
Phlebitis	6	3	0
P O shock	3	0	0
Intestinal obstruction	0	2	0
Deaths	13	6	0
Total complications	143	217	5
Percentage of complications	25 5%	58 3%	15 6%

TABLE VIII

1,016 OPERATIONS FOR HYSTERECTOMY

(Mortality-Rate 3 per cent)

	Morphine-Atropine	Morphine-Hyoscine	Morphine-Barbital
No of cases	444	527	45
No catheterized	136	302	9
Percentage catheterized	30 6%	57 2%	20 %
Cystitis-pyelitis	30	177	2
Percentage cystitis-pyelitis	6 8%	33 6%	4 %
Peritonitis	3	5	0
Phlebitis	7	7	0
Pulmonary embolus	3	2	0
Pneumonia	12	12	1
P O hemorrhage	4	1	0
Deaths	15	15	1
Total complications	165	329	10
Percentage of complications	37 %	62 4%	22 2%

It is interesting to note that the percentage of catheterization was unusually high in pelvic operations, which is in all probability due to the close proximity of the bladder to the operative field

TABLE IX

RESUMÉ SHOWING THE PERCENTAGE OF COMPLICATIONS FOR EACH GROUP OF OPERATIONS

Operation	Morphine-Atropine	Morphine-Hyoscine	Morphine-Barbital
Thyroid	7 2%	10 %	5 2%
Breast	6 7%	13 8%	8 3%
Hernia	13 %	29 8%	10 7%
Appendicectomy	18 7%	27 %	18 %
Gallbladder	24 5%	31 3%	13 6%
Gastro-Intestinal	25 5%	37 8%	21 %
Pelvic Adnexa	25 5%	58 3%	15 6%
Hysterectomy	37 %	62 4%	22 2%

Table IX shows a comparison of the total number of complications that occurred after each type of operation, in the morphine-atropine, morphine-hyoscine and morphine-barbital groups It will be noted that where morphine-hyoscine was used preoperatively the percentage of complications is higher for all operations than where morphine-atropine or morphine-barbital was used

TABLE X

RESUMÉ SHOWING THE PERCENTAGE OF OCCURRENCE OF CYSTITIS OR PYELITIS AS A COMPLICATION IN 7,901 ABDOMINAL OPERATIONS

	Morphine Atropine	Morphine-Hyoscine	Morphine-Barbital
Abdominal operations	5,324	2,318	259
No catheterized	903	822	42
Percentage catheterized	16 9%	25 4%	16 2%
No cystitis-pyelitis	143	319	6
Percentage cystitis-pyelitis	2 7%	13 7%	2 3%
Percentage of those catheterized that developed cystitis or pyelitis	15 8%	38 8%	14 3%

Table X shows a resume of the 7,901 abdominal operations Five thousand, three hundred twenty-four received morphine-atropine preoperatively, 2,318 morphine-hyoscine, and 259 morphine-barbital Sixteen point nine per cent were catheterized in the morphine-atropine group, 25 4 per cent in the morphine-hyoscine group, and 16 2 per cent in the morphine-barbital group In the morphine-atropine group, 2 7 per cent developed cystitis or pyelitis, 13 7 per cent in the morphine-hyoscine group, and 2 3 per cent in the morphine-barbital group Of the 903 patients that were catheterized, in the morphine-atropine group 15 8 per cent developed cystitis or pyelitis, 38 8 per cent in the morphine-hyoscine group, and 14 3 per cent in the morphine-barbital group

The higher percentage that developed cystitis or pyelitis in the morphine-

hyoscine group is in all probability due to the fact that each individual patient needing catheterization, was catheterized more often than the patients in the other groups, since the narcosis was more prolonged

CONCLUSIONS

1 From this study, one is justified in concluding that preoperative medication definitely influences the postoperative complications

2 When morphine and hyoscine are used preoperatively, the percentage of postoperative complications is higher than when morphine is combined with atropine or one of the barbiturates

3 The combination of morphine and one of the barbiturates, apparently shows the least number of postoperative complications, but the group reviewed is too small from which to draw any conclusions

DISCUSSION —DR JOHN W PRICE (Louisville, Ky) —This subject that Doctor Mastin has brought up is, I think, very timely It is one that has interested me for a great many years, and especially the use of morphine both as a preoperative and postoperative medication At one time I saw two striking examples of ill health following the use of morphine by a reputable physician One of these cases was a very beautiful girl who had been made an addict by one of the safest practitioners of my acquaintance Another was an elderly lady whose physician was thoughtless, and she had become an addict So I decided that I would experiment with the least amount of morphine that I could do with for my cases, both preoperative and postoperative, and we started out giving no morphine preoperatively, and then we told the house staff that only those cases which seemed definitely uncomfortable postoperatively, should be given morphine We carried that out on a series of only 200 That is not a large number, but we did find in the end that we had given only an average of one-eighth gram of morphine per patient, which meant that many had no morphine either before or after operation

Doctor Mastin's statistics show the complications following the use of morphine and hyoscine and, as I understand it, they are all taken from one hospital, where catheterization is performed by the same staff of nurses, orderlies or interns, and that there is a great difference between the complications following catheterization on the cases that have had hyoscine, morphine, barbital, and atropine One would think the technic of catheterization was the same throughout, and one wonders why the percentage of pyelitis following catheterization should vary, unless the cases that had morphine and hyoscine had to be catheterized much more frequently than the cases that did not

DR LUCIUS E BURCH (Nashville, Tenn) —I should like to ask the speaker whether he has statistics on complications following general anesthesia and those following local I also have one suggestion to make in avoiding complications, especially pyelitis and cystitis, and that is, if the case is not an emergency one, to teach the patient for a day or two before operation to use the bed pan and urinal

DR E V MASTIN (closing) —In answer to Doctor Burch's question I was unable to notice that the anesthetic played any part in the number or type of complications In the review of the first 1,000 cases I checked the complications following each individual anesthetic, and I did not notice that the percentage was varied enough to carry it out for the entire group

INTERNAL FIXATION OF FRACTURES OF THE NECK OF THE FEMUR

AN ANALYSIS OF RESULTS

RALPH G CAROTHERS, M D

CINCINNATI, OHIO

WE BELIEVE that enough successful cases of internal fixation of fractures of the neck of the femur have been reported to make most of us at least conscious of the fact that it is a good method of treatment One test for any particular form of therapy is its applicability We have not only made internal fixation our method of choice but have been able to employ it in almost all of our cases During the last three years all of our intracapsular fractures, with two exceptions, have been so treated, and if we had to do those two over again, we believe, in the light of our increased experience, that we would use this method now At first, we did not use pins at all in cases of intertrochanteric fractures, and a good many patients were treated by other methods In the last two years, however, we have consistently used internal fixation, except when the outer fragment has been so comminuted that it was felt that it would not be strong enough to hold the pins We wish to discuss a few of the difficulties which have been encountered, and to describe the technic which has been developed

In the first place, it must be stated that we selected the Austin Moore method of treatment as being, in our minds, superior to either the Smith-Peterson nail or Kirschner wires We felt at that time (1935, before blind nailing or wire guides had been developed) that the Smith-Peterson operation was too severe and too hazardous for the vast majority of cases and that the wires were too inadequate We, therefore, prepared ourselves to apply the Austin Moore method of treatment to our cases and tried our best to follow his technic as he had originally published it We learned, however, that a great many details had not been covered in his original communication and we had to develop our own methods to deal with these contingencies

In the beginning we were unable to judge the length of the pin to be inserted, or rather we were unable to judge the dimensions of the bones as they appeared in the roentgenogram As a consequence our first pins went in too deeply and crossed into the acetabulum This, of course, was not desirable, and in order to avoid it, there was a tendency to put our pins in not quite deep enough It was discovered that the pins must go into the cortical structure of the head If the pointed ends of the pins stop in the cancellous structure of the bone they will not hold well, even though they have crossed the line of fracture We believe, therefore, that it is quite important to get them in quite deeply but not too deep

It has been the problem of properly directing the pins, however, which

has caused us the greatest concern We have now developed a technic which we believe to be quite satisfactory and which can be easily employed All of our cases are operated upon the Hawley table Before putting the patient on the table we substitute in place of the pelvic rest a tunnel through which roentgenologic casettes can be shifted As soon as the area is anesthetized either with local, spinal or general anesthetic, as one desires, the fracture is reduced, and the feet tied to the foot pieces of the Hawley table, the legs

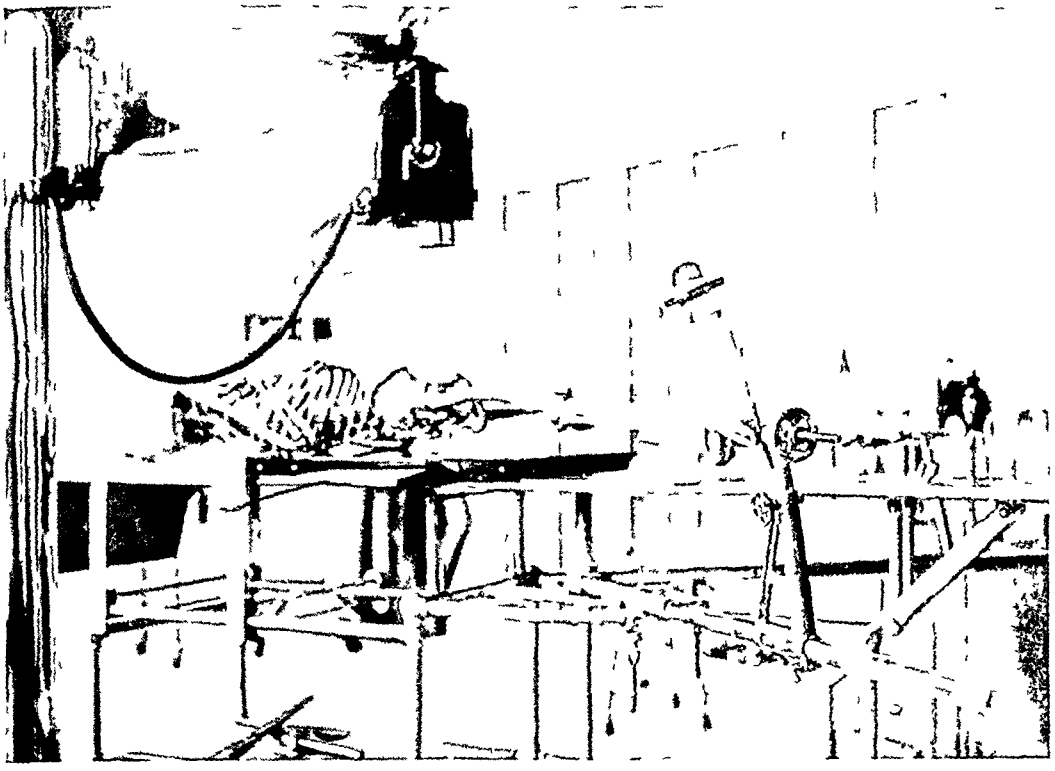


FIG 1 —Method of Getting an Anteroposterior View of the Fracture The fracture has been reduced and the feet have been tied to the foot pieces, so that the position of the fragments remains constant throughout the operation

being placed in a fair degree of abduction Following this the middle of Poupart's ligament is marked with gentian violet, and at the same time a clip is placed in the skin at this point Two roentgenograms are then made, one in the anteroposterior, and the other in the lateral direction, for which latter purpose we use a curved casette placed between the thighs We do not shift the leg for the purpose of obtaining a lateral view, in fact, we do not move the leg at all until the operation is over While these pictures are being developed, the operator can finish scrubbing up, and the patient can be painted and draped Examination of the roentgenograms then determines whether or not the reduction is good (if poor, the fracture is reduced again), and one is also able to determine the exact angle of the neck in relationship to horizontal In other words, the curved casette upon which the lateral picture has been made has been placed firmly upon the Hawley table, and, therefore, the lower edge of the film is parallel to the Hawley table and consequently horizontal

The neck of the bone is clearly outlined upon this film and its angle with the horizontal is easily seen In order to transfer this angle to the operator,

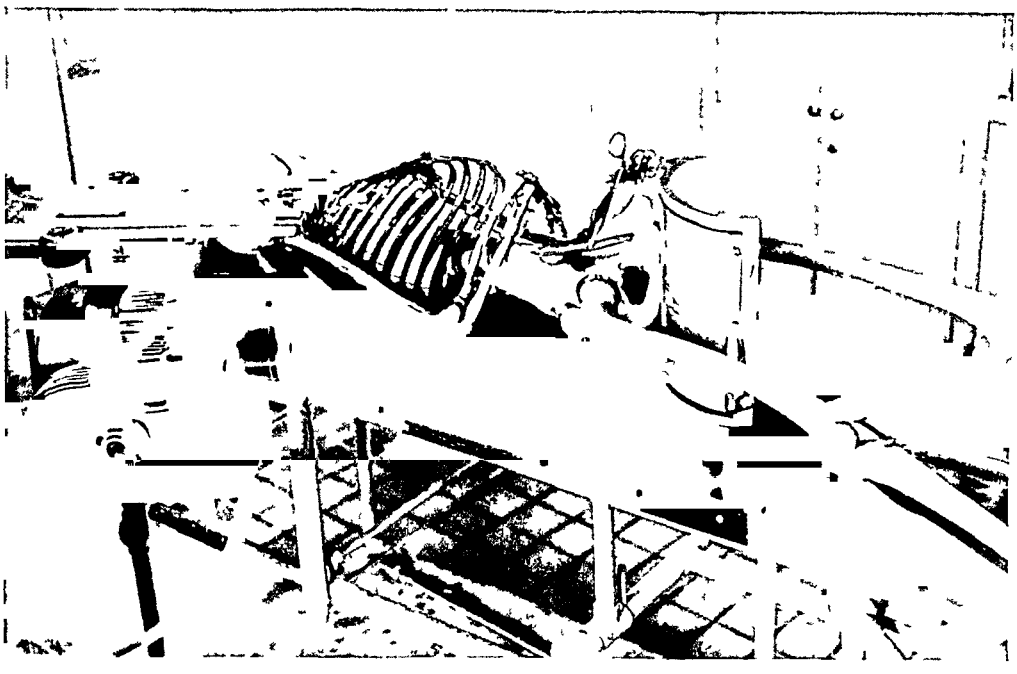


FIG 2 —Method of Getting a Lateral View of the Fracture The curved casette is placed upon the table firmly which causes the lower edge of the film to be horizontal The lateral angle of the neck as it appears at that moment, with the feet tied as they are is easily seen on the resulting film Note hemostat clamped to Poupart s ligament at its middle is directly over center of acetabulum



FIG 3 —With one edge of the card held parallel to the lower edge of the film the other edge of the card can be cut to show the angle of the neck

the roentgenologist can quickly and easily cut a card in such a fashion that one edge is parallel with the lower edge of the film, and the other edge is parallel to the center line of the neck, as viewed in the lateral position When

the operator is about to insert his pins, someone can stand at the head of the table with his eyes at the level of the incision and holding this card with

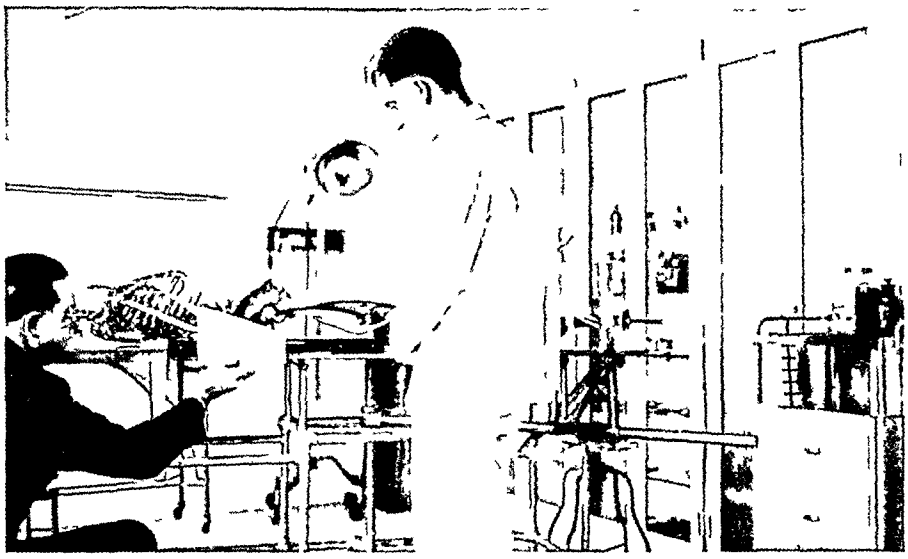


FIG 4.—This card is held by an assistant who can line up the pin in the proper direction with his eye

one edge horizontal, can tell the surgeon whether to thrust his pin up or down or level, as the case may be He does this by paralleling the direction



FIG 5.—An Allis forceps has been placed at the middle of Poupart's ligament Looking at the the patient from above, it will be seen that it is situated directly over the center of the acetabulum, and that a pin directed toward this point will go into the head

of the pin with the line at the edge of the card The operator himself can aim for the head of the bone in the anteroposterior view by aiming for the skin clip which has been previously placed The anteroposterior roentgenogram will show whether this clip is a little too high, too low, or in the right

place, and one can judge any slight change in direction which might have to be made

With these preparations, and the cooperation of a reliable roentgenologist, the operation is simple As soon as the preliminary roentgenograms show a



FIG 6—Lateral view This shows the pins introduced Lateral view of the neck of the femur showing pins running down the neck into the head It also shows the angle of the neck to the horizontal

good reduction and a proper angle of the neck, a four inch incision is made and the muscle split down to bone No attempt is made to raise the periosteum Three pins are then inserted using the method which has just been

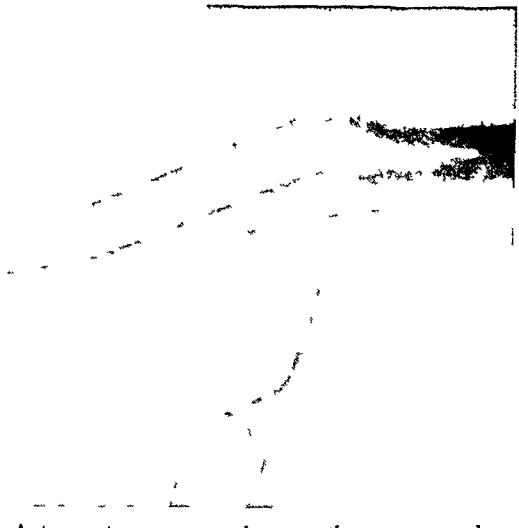


FIG 7—Anteroposterior view showing the pins in place One pin is a little high The others are well placed but the nuts are not tight against the outer fragment Note that the upper towel clip, which has been placed over the middle of Poupart s ligament is directly over the head of the femur

described for directing them The pins are held in a simple brace which has a long narrow end In this end, a hole has been drilled and threads have been cut The butt end of a pin can be screwed into this brace and easily held and introduced As soon as this is done, two more roentgenograms are made In order to accomplish this, a large sheet is thrown over the table

and the exposures can be made without contaminating the field When these films have been inspected and it is seen that the pins are properly placed, they are then driven home This particular matter is of very great importance It is a well known fact, but one which has not always been appreciated in this work, that when a nail is driven through one board into another, the tendency is for the second board to be forced away from the first as the nail goes into it It is only when the head of the nail engages on the first board that the two are finally brought together This is accomplished with the last two or three blows of the hammer Therefore, when it is seen that the pins have been properly placed as to direction, one can judge how much deeper they



FIG 8—Anteroposterior view showing pins which have been in place six months Patient is walking Note the points apparently going into the acetabulum but there has been no pain or difficulty whatsoever These pins were removed soon after this picture was taken and came out with great difficulty The pins were made of chrome steel and the nuts of brass

should be driven in, and the nut screwed up to the distance determined Then with a nail set, each pin can be driven home until the nut has engaged against the outer fragment and shoved it in, so as to impact the fragments The excess of the pin is then clipped off and the wound closed

Many of the patients are helped out of bed within a few days Weight bearing is not permitted, but movement of the hip is encouraged The patient is urged to walk as soon as possible with crutches, and to bear light weight on his leg at the end of about six weeks

The results which we have obtained in a rather small series of cases are not remarkable, though we feel that they are really quite satisfactory One difficulty in appraising any method of treatment of fractures of the neck of the femur is that it takes a considerable length of time, several years in fact, to determine the actual end-result in each case, and during that period of time some of the patients may have died of other conditions It has also been the habit of a good many clinicians, ourselves among them, to report

results as better than they really were In other words, if a patient was getting about at the end of a year, many surgeons might report bony union We have been surprised, however, to find patients, who had been reported as cases of good bony union, return after four or five years for some other condition, when it was found that the hip was anything but good The patients themselves were quite satisfied, and were walking fairly well but the roentgenograms showed a condition that was far from that which we had supposed it to be

With these remarks in mind, we will try to appraise the results obtained in the 26 cases which we have pinned Of these, 17 were intracapsular fractures of the neck of the femur and nine were intertrochanteric In the intertrochanteric group, one died of apoplexy within a few weeks after injury Of the eight remaining, seven have firm bony union in excellent position The other case has good union but poor position This was the first case in which we employed the pins, and they were not well placed They all became loose and began to migrate Each was removed separately through a small nick in the skin It may be interesting to note, at this point, that loose pins have invariably resulted when the pinning was mechanically imperfect In our experience, if a pin has been driven through good bone into good bone and solidly fixed, it has remained fast If a pin has been improperly inserted, it has become loose The looseness which we have seen in connection with improperly placed pins is the only evidence we have of electrolysis of bone around the metal Each of our pins has been made of chrome steel and upon each has been threaded a brass nut Recently, however, we have used chrome steel nuts so that only one type of metal is involved, but even so,



FIG 9—Anteroposterior view showing the pins in place These have now been in about three years and are causing no trouble whatsoever

there have been no cases of bone absorption around the pins when the pin has been mechanically well placed

Of the 17 cases of intracapsular fractures, two died early We do not believe that these deaths were the result of the operation and feel certain they would have occurred as the result of any form of treatment Of the remaining 15 cases, there are five in which we believe we have firm bony union in excellent position The most recent of these five cases was operated upon seven months ago, the others range up to two and one-half years There are four cases in which the head of bone has become necrotic and is gradually being absorbed Each of these patients is walking with a cane or crutch and getting along fairly well Each has some type of fibrous union and not one of them seems to be a candidate for reconstruction There are two cases in which we believe we have firm union, but who have some limp One case died of pneumonia within ten weeks after the operation Up to that time it appeared as if she would have an excellent result Three other cases are too recent to report as final * One, operated upon three months ago, has no pain in her hip, handles it as though there were nothing the matter with it at all, and under our direction is bearing some weight We believe she could bear full weight if we permitted it Another has gone about the same length of time, but was unfortunate in having a fat infection which has kept him in bed I believe we are getting bony union in this case A third one was operated upon only a few weeks ago Although he is properly pinned in excellent position, he still complains of pain It is interesting to note that this man seems to be running the same course as was run by each of those cases in which necrosis of the head took place We do not know this for certain, but it seems to be apparent that in those cases in which the head became absorbed there was more pain than in those in which the head remained viable We are not certain whether or not this may be similar to an osteoporosis

CONCLUSIONS

(1) We believe that internal fixation is a good method of treatment for fractures of the neck of the femur Not all cases have been cured, nor can we expect to cure all cases in the future, but compared with other methods, we believe that internal fixation is the most effective yet devised

(2) The technic of properly introducing the pins must be mastered if one is to expect success

* Since this paper was written, two cases which were listed as being too early to report now show good bony union One, a man, age 86, with a central fracture of the neck of the femur has an excellent result Another, a man, age 63, with a central fracture of the neck shows good union

LUMBOSACRAL AND SACRO-ILIAC STRAIN CAUSING LOW BACK PAIN

A REVIEW OF ONE HUNDRED FIFTY CASES

EDGAR LORRINGTON GILCREEST, M D

SAN FRANCISCO, CALIF

FROM THE DEPARTMENT OF SURGERY OF THE UNIVERSITY OF CALIFORNIA MEDICAL SCHOOL SAN FRANCISCO CALIF

FORMERLY we considered backache as Mark Twain said we considered the weather, namely, we talked about it much but did little about it We knew that no one actually ever died of backache and, therefore, the sufferer from this condition received little sympathy It is difficult, however, for any one to concentrate on his work when he is experiencing a dull backache If one thinks that it amounts to little ask the person who has it Backache is not a disease, but a symptom—often an outstanding solitary symptom The patient seeks advice not alone for the pain but on account of incapacity to work It accounts, therefore, not only for much irritability but also for much disability, frequently in the most muscular and robust laborers as well as in many office workers In fact, I believe there is no one condition which produces more disability and economic loss and, therefore, is so costly to industry as low back pain

As the subject of low backache has steadily acquired more prominence during the past 25 years, a perusal of the literature during that period will reveal an increasing number of contributions concerning it Its causes are many Some of these causes have been individualized and, because of their importance and preponderance, different clinical syndromes have evolved gradually from the so-called lumbago, once such a vague condition because so generalized No longer are we content to pigeon-hole this condition under that caption with the hope that time and a bottle of liniment would bring about at least an amelioration, if not a complete relief of symptoms Patients with low back pain are seen often first by the general practitioner who may not recognize the nature of the lesion and do little to relieve the pain Consequently, sooner or later, the patients drift into the hands of a chiropractor, an osteopath, a naturopath or some other cultist who relieves them by the manipulation of their back As there are few patients more grateful than these sufferers, henceforth they think of these cultists for the relief of all their future ailments It behooves us, therefore, to take the subject of low backache seriously

Because of its many etiologic factors, low back pain remains still a perplexing problem Among its chief causes should be mentioned posture, trauma, infection, congenital anomalies and neurologic, metabolic and neoplastic conditions Instead of one of these, several may be responsible for the disability The majority of cases of backache will fall into three main groups Ortho-

pedic, gynecopathic, and urologic [10] Certainly acute and chronic sprains are responsible for the greatest number Next to trauma in frequency as an etiologic factor comes infection, frequently the two coexist, and when they do it is difficult to even attempt to decide which is playing the more important rôle A congenital anomaly or a faulty posture predisposes to strains or slips in the low back and greatly retards the recovery when they once occur Neurologic, metabolic, neoplastic conditions and protrusion of an intervertebral disk must be considered and eliminated before any rational treatment is instituted Arthritis cannot be associated very definitely with backache unless there is some acute condition present There is no scientific proof that it is the cause of pain The most extensive arthritis is seen in strong stevedores who have never had a backache In this paper we shall not consider those various factors but *shall confine the discussion to the so-called strains and slips of the* lateral lumbosacral and sacro-iliac regions

Anatomic Considerations—*Lumbosacral Region* In considering low back conditions one must bear in mind the rôle of the lower segments of the spine and especially the lumbosacral region Here one finds innumerable anomalies and osseous variations[4] which, although asymptomatic, nevertheless contribute to render this region of the human body mechanically less strong To these one must add structural variations of the soft tissues which are usually more difficult to demonstrate Because of these multiple variations it is difficult for one to decide when looking at roentgenograms of the lower back what is and what is not normal

In the review of the literature one finds a moderate degree of unanimity of opinion as to the part played by these vertebral anomalies in production of low back pain and the mechanism by which this pain may be explained [1,2] Chamberlain[2] has called attention to anomalous fissures, of developmental origin, which are mistaken for small linear fractures These anomalies and the consecutive weakness of this segment of the spine are the result of the changes this area has undergone in our development from the quadrupedal to the bipedal posture [17] These changes make this area a weak point when, from the upright position, one assumes the quadrupedal position and to this the elements of weight lifting, rotation or twisting are added

Furthermore, the lumbosacral region is at the junction of a flexible and mobile section of the spine with the fixed pelvis This junction is at a variable angle which increases the instability of this region As Smith-Petersen[14] points out, the joints of the lower back are (1) The articular facets, (2) the intervertebral disks, and (3) the sacro-iliac joints The articular facets are so interlocked as to give freedom in flexion and extension and to allow minimum amount of rotation The anatomic variation of the facets not facing in the sagittal plane does not itself give rise to symptoms but results in increased mobility in rotation and, therefore, predisposes to strain Any other anatomic variation, such as sacralization of the transverse process of the fifth lumbar vertebra, especially if unilateral, has a tendency to render the function of the lumbosacral junction asymmetrical and, therefore, predisposes to strain

In the traumatic low back disability, which I am considering, it is surprising to notice that there is no relation between the degree of disability and the severity of the trauma producing it but that "the manner of application of the force rather than the degree of the force is the outstanding factor in these injuries"[4] Factors to be considered, although constantly varying, are also the resistance and adaptation of the back to the forces acting upon it[9]

In the mechanism of production of these slips, one has to remember, as Troedsson[17] has emphasized, that "the stability in this area in a stooping or lifting position is to the greatest extent dependent upon the tropism of the articular facets and the direction of the articular processes of the fifth lumbar vertebra"

To understand this one must consider the comparative anatomy "In the quadruped the superior articular facets of the sacrum lie in the horizontal plane and receive the inferior articular processes of the fifth lumbar vertebra This overlapping gives a very effective bony support to the body weight at the sacral end as it hangs between the shoulder and the pelvic girdles With the assumption of the erect posture in man and a consequent great loss of weight-bearing function of these processes, there has been a change in their direction as well as in the direction of their articular facets" These processes in the lumbosacral region will have a tendency to slide, especially when there is an upward pull on the sacrum such as in lifting

Sacro-Iliac Region—The architecture of this joint is such as to limit or minimize any rotatory movement In fact, reasoning *a priori*, many surgeons claim that a sacro-iliac slip never occurs except as the result of a severe trauma, such as a fall from a great distance or a severe, direct blow It has remained, therefore, a controversial subject since Goldthwait and Osgood,[6] in 1905, introduced it as a clinical entity In 1933, Reginald H Jackson[8] reported a number of cases not due to severe trauma Chamberlain,[3] a roentgenologist, also believes it is a definite clinical entity, and that a relaxation of this joint can be demonstrated roentgenologically in some instances

History—An accurate history is always essential and at times the most important part of the procedure, especially in industrial practice or medico-legal cases in which the element of exaggeration or malingering has always to be considered The frequency of patients simulating backache, and the difficulty often in proving the nonexistence of it, has caused this condition to be called by some "the compensation disease"[16] A detailed description of the pain, that is in relation to its onset, whether or not it was associated with a trauma, location, radiation, duration and other factors influencing it, should be elicited, as this will greatly assist in a differential diagnosis This is often a tedious procedure If the pain was associated with trauma, the history will often reveal that it was of a sharp character and was ushered in suddenly during a twisting movement of the spine while leaning over, lifting or pulling, when suddenly his foot slipped or a coworker, who was lifting one end of the load, let go unexpectedly, throwing the entire load on him suddenly He was not prepared for the sudden strain and there was a lack of coordination

Often he will tell you he heard and felt something snap He was unable to continue with his work The next morning on attempting to get out of bed he again felt a severe pain Because of it he has been unable to lean over to lace his shoes The pain will be described usually as constant, located across the lower back or on one side, and aggravated by any movement of the lower spine

The history and examination should be systematic and follow a comprehensive outline in order not to overlook some important information The factor of compensation, of various sick benefits, or of litigation and the influence they may have upon the outlook of the patient, should always be kept in mind by the attending physician Often it is necessary to obtain this information from others than the patient The malingerer is usually very vague and varied in the description of his symptoms To a good listener he will be profuse in his remarks

Examination—After a thorough history has been taken, the examination includes a careful note of their gait, the attitude of standing, method of sitting or arising from a chair [15] Often a complete physical examination is necessary to properly evaluate the factors causing a back condition of long standing, but in the acute cases, to which I refer, the examination is usually limited to the back The patient should have the entire back and hips exposed One should notice the presence or absence of *postural changes* or defects, muscular atrophies and muscular spasms If the patient is examined in bed or on a table it will be observed that he lies on his unaffected side with the affected limb flexed at the hip and the knees The lumbosacral region will be flattened

Areas of tenderness are elicited by palpation and percussion Smith-Petersen, in 1924, outlined a routine examination in such cases which will be of assistance to those interested in the subject

As Kuhns[9] pointed out, the examination of the spine should also be made both supine and prone, in a position as symmetrical as can be assumed with comfort "Consistently localized tenderness is of the greatest importance in determining the type of lesion Tenderness, of course, is a subjective manifestation and, therefore, its importance may be questioned In most instances an experienced examiner can tell whether a patient's response to percussion or palpation is overdone or feigned The moment of response is never accurately timed by the malingerer He responds too quickly as a rule, sometimes too slowly"[5]

Movements—They should be tested to determine their range and any degree of limitation in the three different positions Standing, sitting, and lying [13] Guarded motion of the spine is early assumed by the patient In these conditions one will notice that the patients "walk with a shuffling gait, and body bent slightly forward and the lower back held rigid It is difficult for them to sit down or get up, and almost impossible for them to take off their shoes" They complain of pain across the lower back, at times radiating to the groin or towards the buttocks on one or both sides [17]

Diagnosis—Only a thorough history and a careful analysis of every sign

and symptom will permit an accurate diagnosis in cases in which the low back is affected There are many special tests in the examination of a back, which are best carried out by the patient lying down on a table These tests are helpful in differentiating between a lumbosacral and a sacro-iliac condition

Lumbosacral Strains—In these the pain is over the fifth lumbar and the lumbosacral joint, and this joint resists movements of the spine in all directions There is tenderness over the fifth lumbar and first sacral vertebrae and in both iliolumbar notches

The tests suggestive of this condition are

(1) Prone thrust in hyperextension test is best carried out by having patient raise himself up if possible from table A sudden thrust over the lumbar region will produce or aggravate the pain in lumbosacral cases

(2) Forward bending does not reverse the lumbar lordosis in lumbosacral sprains

(3) Nachlas' sign—hyperextension of the thigh with the patient prone and the knee flexed, may produce pain in the lumbosacral joint, suggestive of a lesion there

(4) Goldthwait's sign—inability to flex the thigh with the knee extended, does not become positive until the leg has been raised quite high

(5) Patrick's sign—forced abduction of the flexed thigh, elicits no pain

Sacro-Iliac Strains—In these there is pain over the posterior aspect of the joint which becomes worse at night If the pain is unilateral it is relieved by sitting on opposite buttocks In extreme cases there may be some swelling over the joint There may also be painful areas over the second, third and fourth sacral vertebrae with radiation down the sciatic nerve The accompanying muscle spasm has a tendency to make the whole spine list, usually to the affected side

The following tests may be found useful

(1) Kernig's sign is positive on the affected side, with the patient lying on his back and the extended leg being flexed as far as possible on his abdomen A normal leg can be flexed to 100°, while the affected leg can only be flexed through a much lesser range without producing definite pain When this sign is positive it is suggestive, but not pathognomonic, as it occurs in other conditions where the sciatic nerve is involved

(2) Straight leg raising is usually limited and painful, more on the affected side regardless of the leg tested The pain is felt in the low back, either in the lumbosacral or sacro-iliac region The examiner should have one hand under the lumbar region and if the pain is complained of before this portion of the spine begins to move, this reaction suggests a sacro-iliac condition

(3) Compression of the iliac crests and pressure over the pubes may bring on or aggravate the pain in the sacro-iliac joint

(4) Cross leg sitting test increases the pain

(5) Goldthwait's sign is manifested immediately the heel is raised from the bed or the table

(6) Patrick's sign is occasionally positive, pain being produced over the sacro-iliac joint

(7) Ober's sign[11] is positive if the fascia lata is contracted This consists in adducting the extended leg with the knee flexed at right-angles and the patient on his side

(8) Ely's sign may be positive in sacro-iliac sprains—forcible flexion of the leg on the thigh causes the pelvis to rise off the table and produces pain

Treatment—In recent cases of lumbosacral and sacro-iliac strains, deep heat is applied over the lower back for 15 to 30 minutes followed by deep massage for a few minutes and then manipulation is carried out The following procedure has been found helpful The patient lies on his back on a narrow, firm table He is told to relax The manipulator, standing at the end of the table, grasps in each hand the patient's heel and ankle and slowly and gently rocks, with a rotatory motion, the lower limbs on the pelvis, reassuring the patient and thereby obtaining the relaxation desired One lower extremity is then allowed to hang over the side of the table and the other is flexed on the pelvis in order to hold the pelvis steady Pressure is then gently, but firmly, exerted on the limb hanging over the edge of the table for a few minutes, while counterpressure is exerted on the flexed limb The position of the limbs is then reversed and the maneuver repeated

The patient is then put on his side with the lower extremity, nearest to the table, extended fully and the other one flexed at the knee Pressure is exerted downwards on the flexed knee while counterpressure is put on the shoulder of the same side so as to obtain a rotation of the spine, clockwise of the pelvis, and counterclockwise of the shoulders This same maneuver is repeated with the patient on the other side, changing the position of the legs During this maneuver, which must also be carried out gently but firmly, a definite snap is frequently felt by the patient and may even be audible to bystanders When this occurs the pain usually ceases instantly, the patient is completely relieved or may feel only a soreness in the low back The movements of the back immediately become freer, and the patient delights in trying them out, and as soon as he gets off the table will, almost invariably, bend forward, a movement which he could not make previously, to see if he can reach to his shoes

Another simple and quick manipulation which may work well in some patients who are not too large or heavy is as follows Stand the patient back-to-back with yourself, and then put your arms under his axillae and lean forward, lifting him up on your back, hyperextending his lumbosacral region, and then suddenly give a hump or jump which will often instantly relieve him

In the less severe cases an elastic belting is applied to the low back and pelvis In the more severe cases of relaxation of the sacro-iliac joint a stronger support, such as a buckskin or army belt, is ordered This belt is placed on a level with the third sacral vertebra between the anterior superior spine and the trochanter and held in place, if necessary, by two perineal straps The patient is then instructed in the care of his back, *i e*, to sleep on a hard bed which does not sag in the middle Boards put in the middle of the bed

between the springs and the mattress will often prevent the spinal sag As a further aid in relieving the soreness in the lower back the patient is instructed how to sit down and arise from a chair without bending the lower back A brief course of physiotherapy, consisting of deep heat and massage, may be necessary for a short time If the posture is poor and the tone of muscles weak, corrective exercises should be instituted Where there is a pronounced lumbar lordosis the patient is instructed in the following To stand, letting weight come on ball of foot rather than on the heel or arch, to contract the muscles of the leg, thigh, and buttocks, to push the pelvis forward, to draw in the abdomen, and to let the shoulders fall naturally rather than to push them back

In more severe cases, especially old sacro-iliac strains, manipulation may be best performed under general or spinal anesthesia, followed occasionally by the application of a plaster encasement of the body, as suggested by Jackson [8] It has seldom been found necessary, however, to apply this In these cases manipulation consists in flexing the leg on the body until the toes reach the forehead, as described by Baer [1] It may be necessary to perform this procedure in two or three stages, especially in old cases with adhesions and contractures In some patients with severe pain it is often advisable to put them to bed and apply traction to the lower extremities and administer sufficient anodynes to give relief After the plaster encasement is removed it may be necessary to substitute a short Taylor brace for it, and this in turn by a belt with a Cooke pad over the affected side

Old cases require a more thorough investigation, especially for foci of infection Anteroposterior, lateral and also oblique roentgenograms should be taken If foci are found these are eliminated, if possible, or treated Infection in the gallbladder has been known to produce so-called recurrences of "lumbago" which would cease entirely after a cholecystectomy Infection in the prostate and seminal vesicles may be the sole cause of low backache in some patients and a contributing cause in others In many patients the prostate is not a factor, even though a prostatitis may be present A thorough rectal and proctoscopic examination should eliminate any pathology in the lower bowel

CONCLUSIONS

(1) Lumbosacral and sacro-iliac strain causing low back pain is a definite clinical entity

(2) Many of the sufferers of this condition go outside of the medical profession for relief

(3) There are few patients more grateful for relief than the sufferers with low back pain

(4) A very careful history and thorough examination will often lead to an early diagnosis

(5) Of the 150 cases reviewed in this series, the youngest was age 19, and the oldest age 80 The majority were in middle life

(6) This condition occurred more often in the strong, robust, muscular individuals

(7) Arthritis, *per se*, was not an important factor in the production of the pain or the disability

(8) Roentgenograms usually give little aid in the diagnosis

(9) Low back pain is a favorite complaint of the malingerer

(10) Trauma was the cause of the condition in the majority of the cases

(11) The manner of the application of the force, rather than the degree of the force, is the important factor in the production of these lesions

(12) Early treatment by manipulation, and a belt if necessary, will effect a prompt and often permanent cure in the majority of cases

(13) A plaster of paris body encasement was applied to ten patients in the series This form of treatment is however, being employed less frequently by the author, although it has its indication

(14) The disability in those treated with a plaster encasement averaged several months and was prolonged by many contributing causes

I wish to express my appreciation to my associate, Dr Piero Albi for his assistance in the preparation of this paper

REFERENCES

[1] Baer, W S Sacro-iliac Sprain Johns Hopkins Hosp Bull 27, 159 1917

[2] Chamberlain, W E X-ray Examination of Sacroiliac Joint Del State Med Jour, 4, 195–201, September, 1933

[3] Chamberlain, W E Symphysis Pubis in Roentgen Examination of Sacro-iliac Joint Am Jour Roentgenol, 24, 621–625, December, 1930

[4] Galland, W J Low Back Pain Arch Phys Ther, 18, 16–25, January 1937

[5] Ghormley, R K Diagnosis of Low Back Disability Med Clin N Amer, 21, 893–907, May, 1937

[6] Goldthwait, Joel E, and Osgood, Robert B A Consideration of the Pelvic Articulations from an Anatomical, Pathological and Clinical Standpoint Boston Med and Surg Jour, 152, 593–601, 1905

[7] Hallock, H Diagnosis of Low Back Pain with Sciatica S Clin N Amer, 17, 251–277, February, 1937

[8] Jackson, Reginald H Chronic Sacro-iliac Sprain with Attendant Sciatica Southern Surg Trans, 46, 266, 1933

[9] Kuhns, J G Low Back Pain Rhode Island Med Jour, 19, 131–143, September, 1936

[10] Morris, H L, Langlois, L J, and Brunton, J F Urologic Backache J A M A, 99, 27, 1932

[11] Ober, F R Role of Iliotibial Band and Fascia Lata as Factor in Causation of Low Back Disabilities and Sciatica Jour Bone and Joint Surg, 18, 105–110, January, 1936

[12] Painter, C F Low Back Pain, Etiology and Diagnosis Maine Med Jour, 28, 101–109, May, 1937

[13] Smith-Petersen, M N Clinical Diagnosis of Common Sacro-iliac Conditions Amer Jour Roentgenol and Rad Therap, 12, 546–550, 1924

[14] Smith-Petersen, M N Painful Affections of the Lower Back Christopher Frederick, A Textbook of Surgery by American Authors, 413–431 W B Saunders & Co, Philadelphia and London, 1936

[15] Sucha, W L Low Back Pain Nebraska Med Jour, 21, 418–420 November, 1936

[16] Townsend, Egbert M Personal communication, 1937

[17] Troedsson, B S Lumbosacral Derangement and Its Manipulative Treatment Arch Phys Ther, 18, 10–16, January, 1937

GLASS RODS AND OTHER ITEMS IN THE TECHNIC OF THE ABDOMINAL INCISION

WALLER O BULLOCK, M D

LEXINGTON, KY

FROM THE LEXINGTON CLINIC LEXINGTON KY

THERE is need to provide means of escape of virulent products of infection by Streptococci and anaerobic organisms often found in the neighborhood of a ruptured appendix The entire care of such infection should not be left to the defensive mechanism of the peritoneum, and drainage of this highly contaminated area is, therefore, indicated So far as the infection alone is concerned, a completely wide open wound would best serve the purpose There are, however, other matters to consider, chief of which is the retention of the abdominal viscera within the abdominal cavity Therefore, some form of partial closure must be effected to guard against the sudden stresses and strains induced by the acts of vomiting, sneezing or coughing Tier suture of the wound to the region of the drain's emergence often invites disaster In the words of Hamlet "It will but skin and film the ulcerous place whilst rank corruption mining all within infects unseen", an apt description of the spreading phlegmons of the abdominal wall that too often follow partial closure by tier sutures

How, then, may we leave the wound open and at the same time brace and protect it against intra-abdominal strains?

For the past six years I have employed the method here presented with a gratifying degree of success The illustrations depict the procedure probably better than the descriptive text It consists, however, first, of suture of the peritoneum to within one and one-half inches of the lower end of the wound, then mattress sutures are introduced, usually two on each side alternating one with the other The first one placed near the upper end of the wound enters the skin one inch or more from the edge of the wound, depending upon the thickness of the abdominal wall, through the fascia of the same side, across the wound, and up through the fascia only on the opposite side of the incision, then back to the neighborhood of its beginning paralleling its outward course The second mattress suture is started from the opposite side of the wound, the third and fourth also alternating After placing the sutures they are all lifted up, thus approximating the aponeurosis in the middle of the incision, the sutures are then tied over glass rods (Figs 1A, B and C), which gives an easy distribution of the stress I have found heavy braided silk the best material for these sutures Before tying, the sutures should be slightly relaxed to provide a small gap between the edges of the aponeurosis After tying the sutures the edges of the skin are grasped with Allis forceps and the edges held open, the wound flushed with tincture of iodine and packed loosely

with vaselined gauze This last procedure seems to protect, in some measure, against invasion, probably on the principle of Rutherford Morison's "Bipp"

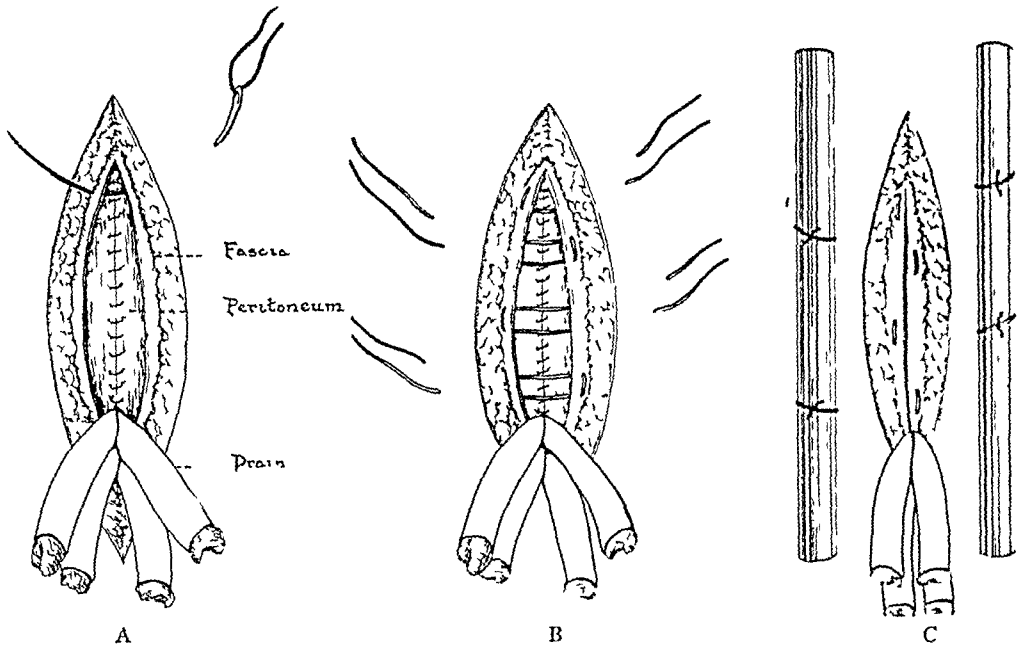


FIG 1.—(A, B and C) Illustrating the various phases of the suggested procedure

paste Release and escape, if one may use a psychiatric expression in this connection, is amply provided and fascial slough is reduced to a minimum The vaselined gauze is removed in 48 hours, and, if there is much soiling, the

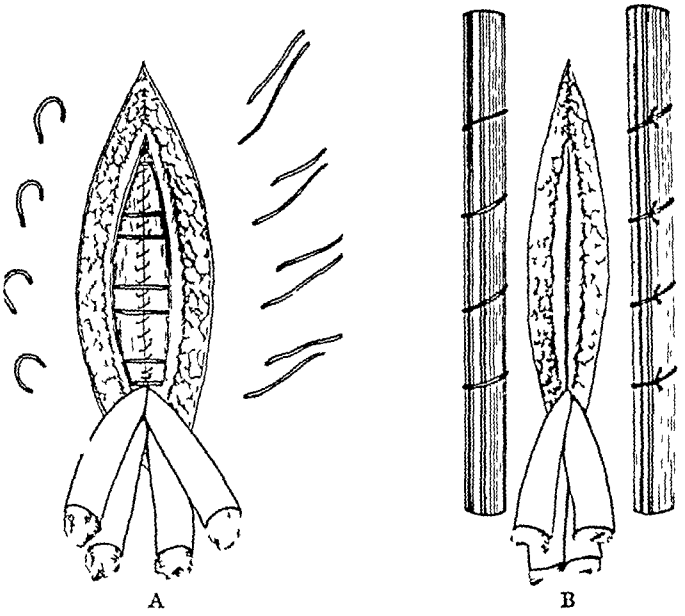
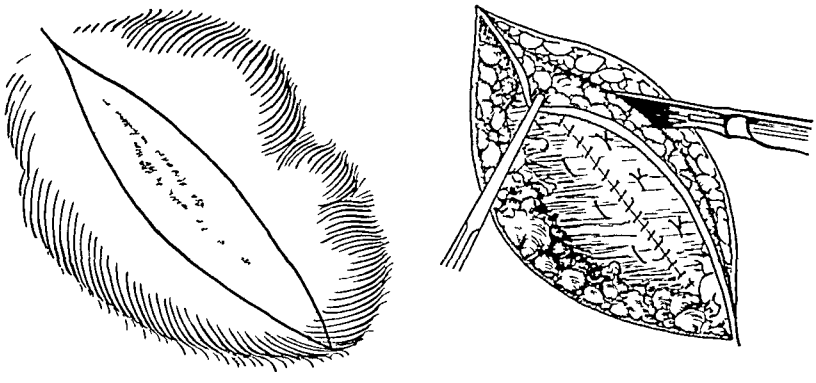


FIG 2.—(A and B) Illustrating the procedures employed in instances of disruption of the abdominal incision

wound and surrounding skin are given a daily cleansing bath of tincture of green soap and sterile water Postoperative hernia in the appendix wound is due largely to fascial slough After six years of employing this procedure,

we have had but one instance of such a hernia Three weeks in bed is a small price to pay for recovery with a sound abdominal wall

Following disruption of the abdominal incision, the use of glass rods to brace the wound will be found to be useful Here the sutures are carried all the way through both sides of the wound if the peritoneum cannot be sutured If it can, it should be, and the procedure illustrated in Figs 2A and B are followed



A B

FIG 3 —(A and B) Illustrating the procedure employed in instances of defective healing resulting from the presence of traumatized or excessive fat

The frequency of infection and troublesome serous accumulations following operations for postoperative and umbilical herniae has caused me much concern Frequently, in spite of the most careful technic, this troublesome complication has occurred In one case of a large umbilical hernia, after the

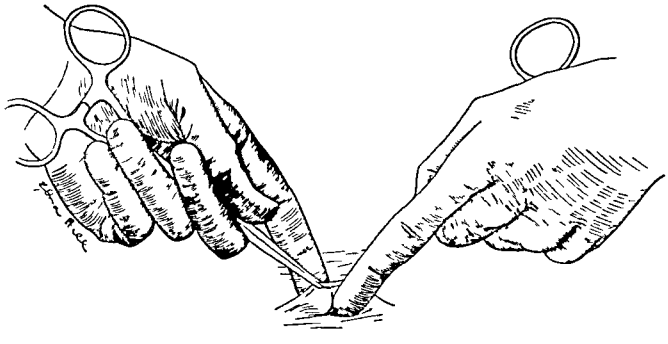


FIG 4 —Illustrating method of avoiding injury to the underlying intestine

aponeurosis had been plicated, the wound was flushed with normal salt solution to clear it of débris, floating in the fluid around the edges of the wound were seen many long threads of fibrous tissue, some with small balls of fat adhering to them, the remains of the septa between the lobes formed by the ectopic loops of bowel Excision of a zone of fat all around the wound down to the aponeurosis leaves a fresh, clean, untraumatized surface that healed per primam in this and all subsequent cases (Figs 3A and B)

Occasionally one is embarrassed to find a small slit present, which has been

made unintentionally into the lumen of the intestine To prevent such accidents we have adopted the technic shown in Fig 4

The peritoneum has been grasped with two hemostats and drawn firmly upward The forefinger of the operator and that of the first assistant are pressed downward in opposite directions on opposite sides, against the web of peritoneum picked up by the hemostats In this way one can be quite sure that no intestine or omentum is caught when the peritoneum is opened, as these structures can be readily felt, and identified if present, in the web, and if not, they are pushed down below the level of the incision out of danger

DISCUSSION—DR R L SANDERS (Memphis, Tenn)—In the earlier years of my surgical practice, I employed the right rectus incision, however during the past 10 or 12 years it has been abandoned in favor of the gridiron or McBurney incision In practically all of our acute cases, the abdomen is opened first through a McBurney incision and if an error has been made, the incision may be quickly closed and any other type employed without any damage having been done Such conditions rarely arise and in almost all cases the appendix can be removed through the smaller anatomic incision

When the appendix is perforated and drains are used, the peritoneum may be loosely closed about them and the entire abdominal wall left open for free drainage If one closes the fascial layers, pus may burrow beneath the planes of the abdominal wall, being the lines of least resistance, and infection of the tissues may occur for some distance In this manner, one may see a superimposed infection in the abdominal wall even after the peritonitis has been fairly well controlled In my own work, the mortality has been definitely reduced by employing the McBurney type of incision and leaving the wound open when drainage is used It is amazing how quickly the wound will clean up Secondary closure is rarely necessary When the wound has become clean it may be drawn together with adhesive plaster Postoperative hernias rarely occur

UVEOPAROTITIS

ALFRED STENGEL, JR., M.D.

PHILADELPHIA, PA.

FROM THE SURGICAL SERVICE OF W. ESTELL LEE, M.D., AT THE PENNSYLVANIA HOSPITAL, PHILADELPHIA, PA.

UVEOPAROTITIS, or uveoparotid fever, was first described by Heerfordt[2] in Germany. Since his original report in 1909, approximately 60 cases have been recorded, of these, only four or five have been reported in America prior to 1937. Thompson[3] reported six additional cases in April, 1937, making no mention of the earlier work of Folger[1] in June, 1936. The latter reported one case in detail and gave a most adequate and comprehensive description of present views on the disease, along with a very complete bibliography, thoroughly reviewing all preceding cases and discussing fully the much argued question of etiology. In Thompson's cases, the eye findings seem fairly suggestive of the disease as originally described, but typical parotid enlargement occurred in only two instances. The inclusion of these six cases as true uveoparotid fever is open to question.

Case Report.—An unmarried colored male, age 32, was admitted to the Surgical Service of Dr. W. Estell Lee in the Pennsylvania Hospital December 14, 1936, complaining of painful, bilateral swellings of the face and dryness of the mouth.

The history of his illness dated from October, 1936, at which time he recalled a certain amount of drowsiness and sleepiness, unusual for him. He had suffered from slight dyspnea, and from a painful tooth. Toward the end of October some small vesicles made their appearance on the lower abdominal wall, and there was an exfoliative skin lesion on the anterior surfaces of both lower legs. The latter resembled the results of a mild burn. It subsequently disappeared. The patient was apparently well until the onset of a bad cold, November 24, which lasted two days, at which time there developed an earache (left ear) and a painless swelling in front of the ear. There was some question about how much pain, if any, the patient suffered in the swollen area, as his story varied on repeated questioning. The swelling gradually increased, and a similar painless swelling appeared on the right side of the face the following day, which rapidly increased in size. Hot towels were applied to the face on two successive days without effect. The patient recalled that on November 29 he felt as though "there was an orange glass in front of the left eye." On December 1 he experienced dryness of the mouth for the first time. Because of the persistence of the swelling he came to the hospital and was first examined December 9. His temperature was 99°F. He was treated symptomatically, and was instructed to use sodium perborate as a gargle. He returned December 14, rather acutely ill, complaining of pain in the swollen areas. There was tenderness over both parotids, and a slight serous discharge could be seen emerging from Stenson's ducts. His temperature was 99.1° F.

The patient had had pneumonia, measles, and pertussis, but never mumps. He also gave a history of a questionable asthmatic attack in 1929. He had sustained no serious injuries and had had no operations. The family and social histories were irrelevant.

Physical Examination, December 14, disclosed a nervous, and apprehensive, colored male with bilateral, preauricular swellings, apparently located in the parotid glands (Fig. 1). These glands were tense, nontender, and nonfluctuant. The pupils were round and equal, both reacted to light, but the right to a greater degree, and more

Submitted for publication December 10, 1937

promptly Corneal opacities and posterior synechiae were noted in the left eye but the fundus was not visualized The nasal septum was deviated to the left, and there was hyperplasia of the left middle turbinate, along with a purulent discharge The ears were normal The mouth appeared dry, and the tonsils were infected The orifices of Stenson's ducts appeared to be swollen Examination of the heart and lungs revealed no abnormalities The liver edge was slightly palpable below the right costal margin There was bilateral inguinal adenopathy The left ankle appeared somewhat swollen and slight pitting edema was demonstrable on pressure over both tibial crests A dermatitis over the tibial crests, noted later, was overlooked at this time

Subsequent Course—Following admission, the patient received roentgenotherapy to the parotid areas without any apparent effect The blood chemistry, serology, and

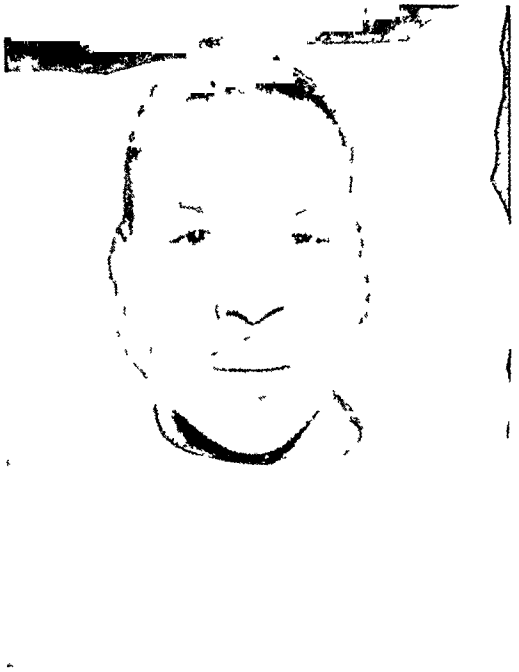


FIG 1—Appearance of the patient on admission Bilateral parotitis



FIG 2—Showing right facial palsy

blood count were essentially negative save for a tendency toward leukopenia and neutropenia Medical and dental consultations were obtained as soon as possible and roentgenograms were taken of the face, for possible Stenson's duct calculi, which were negative

On December 17, right facial paralysis was first noted (Fig 2) This was of the peripheral type and was quite complete An attempt was made by Dr J R Cameron to catheterize the ducts and thus relieve tension from within No fluid was obtained from the right duct, and it was found impossible to introduce the catheter all the way into the left duct

During two successive nights about one week later, the patient complained of rather severe pain in the still-swelling parotid glands Facial palsy persisted on the right side Treatment, other than the procedures described, consisted of purely palliative measures—soft diet, ice bags to the face, chewing gum, and rest in bed Because of vague discomfort in the eyes and slight photophobia, he was urged to wear dark glasses

It was concluded that the patient did not have mumps, nor a duct obstruction, but, rather a chronic inflammatory process in the gland tissue itself, or a neoplasm Neoplasm was considered least likely, since, in this region, one most often finds teratomata As the swelling here was bilateral, this diagnosis was unlikely

The patient left the hospital for the period of a week (December 29, 1936 to January 5, 1937) During this time he presented himself at another hospital where he was

at first thought to have mumps On January 1 and 2, respectively, the right and left parotid swelling began to recede About this time, the patient noted soreness above the left eye

He was readmitted to the Pennsylvania Hospital January 5, 1937, at which time Stenson's ducts were successfully catheterized The catheters were left *in situ* 24 hours, but no drainage resulted The left eye had now become quite painful, and vision was impaired From January 15 on, the patient was constantly under the ophthalmologist's observation The left eye gradually cleared up From the ocular point of view, the diagnosis of uveoparotid fever seemed quite clear-cut

During the remainder of his stay, the patient continued to improve and a number of laboratory studies were made The parotid glands decreased in size so that by



FIG 3.—Appearance on January 21 Showing parotitis subsiding



FIG 4.—Appearance on January 21 Showing evidences of the remaining facial palsy

January 28, they were barely palpable (Fig 3) The eyes improved subjectively, but the facial palsy remained (Fig 4) An infected tooth was extracted February 2 On February 7, patient complained of sore throat and muscular aches Tonsillectomy, under local anesthesia, was advised, but the patient refused operation By February 12 the patient felt so much better that he insisted upon leaving the hospital

He was seen subsequently in several Out-Patient Departments (1) Because of chest pain and dyspnea, thought to be the result of a coronary occlusion (diagnosis not substantiated by electrocardiogram and subsequent course), (2) for the extraction of another tooth, and (3) for further eye treatment The patient has not been contacted since June 23, 1937

Laboratory Data.—Blood counts on eight occasions showed (1) Hemoglobin constantly 90 per cent (14 Gm), (2) red blood cells 4 95 to 6 0 million, (3) white blood cells 2,700 to 5,400 maximum, (4) differential white count, tendency to neutropenia with relative eosinophilia on one occasion Blood platelets 400,000 Coagulation time one minute The fragility test showed beginning hemolysis at 0 38 per cent and hemolysis complete at 0 32 per cent Blood sedimentation rate was rapid on two occasions, namely, 25 Mm on January 25, and 22 Mm on February 3 (one hour's observation) Heterophile antibody agglutination showed two plus in dilution 1 16 and plus-minus in dilutions 1 32 and 1 64 The Kolmer modification of the Wassermann reaction of the serum and the Kahn precipitation test were negative The gonococcus complement fixation test was negative

Blood sugar determinations on four occasions were 87, 87, 77, 79 mg per 100 cc blood respectively Four determinations of the blood urea nitrogen showed 8 6 9 3 8 1 and 8 6 mg per 100 cc blood respectively Two blood cholesterol determinations showed 175 and 190 mg per 100 cc of blood

Fifteen uranalyses showed only a few granular casts in six of them

The basal metabolic rate was minus 8 per cent An electrocardiogram showed nothing abnormal Roentgenograms taken of the chest, sinuses, and of the face, for opaque Stenson's duct calculi, were negative Two tuberculin tests using P P D (purified protein derivative) in strengths equivalent to 0 01 and 1 0 mg of O I were both negative Cultures, taken from secretion found on the soft palate toward the end of patient's hospitalization, showed *Staphylococcus aureus* and *Micrococcus catarrhalis*

Blood cultures were not made, and spinal tap was not performed

Special Examinations—Appended are excerpts from the ophthalmologic reports of examinations made by Drs A G Fewell and M L Kauffman

January 15—Externally the eyes are negative There is no inflammation of the lacrimal glands O D There are numerous fine deposits on the posterior surface of the cornea There is no uveal pigment in the anterior capsule Pupil dilates evenly There is no evidence of posterior synechiae The optic nerve is of good color Disk margins are slightly hazed but definable Veins are dark and full In the extreme periphery of the upper nasal quadrant there is a choroidal lesion O S There is a well marked descemetitis and a practically complete annular posterior synechia The pupil dilates with great difficulty and with much irregularity No lesions could be seen in the fundus There is weakness of the right orbicularis muscle We do not believe this is Mikulicz's disease It might possibly be a case of uveoparotitis O D 6/12, O S 6 15

January 18—There has been no change The right eye dilates well The left pupil is only partially dilated and quite irregular We are unable to break up the adhesions It is thought that this is surely a case of uveoparotitis O D Upper nasal part of the fundus shows some old perivascular changes along with choroidal lesion O S Pupil still only partially dilated with many posterior synechiae, but in nasal fundus there can be seen a small choroidal hemorrhage and some choroidal irregularity A smaller hemorrhage is seen in the upper temporal quadrant

January 25—O D Pupil well dilated Still numerous deposits on Descemet's membrane There are fine vitreous opacities The disk is of good color, with moderately hazed margins The superior nasal vein shows pipe-stemed sheath from midzone out to the periphery In the far out periphery (upper nasal) there is some old choroidal disturbance Inferior temporal vein shows same pipe-stemmed sheath O S Deposits on Descemet's membrane remain Pupil irregular Many posterior synechiae Unable to find hemorrhages in fundus today

February 1—O D More deposits on Descemet's membrane and slight injection of the eye No new fundus lesions seen O S Condition is subsiding, but there are still many posterior synechiae O D 6/15, O S 6/12

February 8—O D There are still a good many deposits on Descemet's membrane, and vitreous opacities The choroidal lesion up and in is less marked O S Quiet Posterior synechiae remain There are no new fundus lesions

The reports of the nose and throat examinations by Dr H B Peacock were

February 1—Both drums and canals are normal There are atrophic crusts with odor from the right nasal chamber without accompanying atrophy of the mucosa The left side is normal Both frontal sinuses are cloudy on transillumination, but both antra are clear Removal of nasal crusts leaves a bleeding, tender area on the mucosa The soft palate and uvula are dry, sticky, and inflamed, with many beads of fluid suspended over the whole These beads brush off with a tongue depressor giving a gritty feel The tonsils are slightly buried with rather marked evidence of chronic inflammation

February 12—The tonsils are chronically inflamed Advise removal under local anesthesia

Discussion and Comment—The case here reported is of interest for a number of reasons The patient appears to present a good example of a rather rarely observed syndrome He presented an opportunity to seek the etiology of uveoparotitis This was, however, unsuccessful Tuberculosis remains the most likely cause The serology was negative, there was a rather constantly observed reduction in the white blood cell count, and there was a minimal pyrexia Tuberculin tests were negative Allergic studies were not made, but this avenue of approach seemed fruitless The lack of fever of consequence, the lack of leukocytosis, and the absence of purulent secretion from Stenson's ducts, and pyopia, seemed to adequately rule out an acute infectious process The teeth and tonsils (and possibly sinuses) could have acted as foci of infection The parotitis was not the result of duct calculi The facial palsy was probably from direct pressure on the nerve, but it could easily have been toxic in origin

The disease is of interest to the internist, to the ophthalmologist, and to the surgeon The internist is concerned with its relation to tuberculosis, its possible early confusion with epidemic parotitis, and the differential diagnosis, including teratoma, syphilis, Hodgkin's disease, and Mikulicz's disease The ophthalmologist is interested primarily in the prognosis for vision This is usually fairly good, though, naturally, synechiae will remain Pupillary activity, then, becomes restricted, but vision is rarely impaired permanently Likewise facial palsy may often entirely clear up The surgeon's attention will be centered on possible biopsy, or open drainage of the apparently much congested and dangerously enlarging glands It may be thought that the chance of a permanent nerve palsy will be decreased by prompt surgical interference These possibilities are mentioned to be condemned A most earnest plea is here made to proceed cautiously, looking for eye changes, for dermatitis, for low fever, for leukopenia, before acting hastily, thereby complicating a condition which ordinarily is self-limited

SUMMARY

(1) A case of uveoparotid fever is presented

(2) This syndrome is characterized by parotitis, uveitis, and low-grade fever

(3) The etiology is not known, but considerable evidence in favor of tuberculosis has been reported in previous papers

(4) The course is mild, the prognosis good

(5) A plea is made for early diagnosis, avoidance of surgery, and watchful waiting

(6) There have been only about 60 cases of this syndrome previously reported in the literature

REFERENCES

[1] Folger, H P Arch Ophth, 15, 1098, 1936
[2] Heerfordt, C F Arch f Ophth, 70, 254, 1909
[3] Thompson, W C Arch Int Med, 59, 646, 1937

SPIVACK'S GASTROSTOMY

AN ANALYSIS OF THIRTEEN CASES WITH A REVIEW OF THE TECHNIC

DAVID H WAGNER, M D

CHICAGO, ILL

WHILE the operation of gastrostomy has been used for many years, the first successful operation having been performed by Sydney Jones in 1875[1] there have always been inherent difficulties connected with its use

The most serious difficulty, which was at first encountered, was the leakage of gastric contents from the opening made into the stomach It was discovered that while food could be satisfactorily introduced into the stomach, there was no way of preventing its return by the same opening through which it was introduced[2] This leakage of gastric contents produced peritonitis and death The problem of peritonitis was solved by the performance of two-stage operations[3] These procedures consisted of fixing the unopened stomach to the anterior abdominal wall, and of opening the stomach several days later, when sufficient adhesions had formed to prevent leakage into the peritoneal cavity The gastric contents no longer caused peritonitis but they poured out on the surrounding skin producing painful excoriation

An effective way of preventing leakage had to be devised before the operation could come into extensive use Witzel,[4] in 1891, Stamm,[5] in 1894, and Kader,[6] in 1896, formed a channel from the anterior wall of the stomach which was lined with serosa This procedure, to some extent, solved the problem of leakage but introduced a new one, namely, obliteration of the serosal lined fistula by the formation of adhesions between the two serous surfaces of the tube

The progressive obliteration of the tube makes it increasingly more difficult to introduce a catheter through which the patient is fed If the operation is performed for benign esophageal stricture, where life expectancy is a considerable length of time, the obliteration of the tube becomes a serious matter, because the patient cannot be fed, and is confronted by the necessity of a new operation to reestablish the communication to the stomach Another difficulty in this type of operation is that should the catheter inadvertently be pulled out shortly after the operation, it is extremely difficult to reinsert it in the proper place, and lack of knowledge of its exact location may cause liquid food to be forced outside of the stomach into the general peritoneal cavity and cause peritonitis This type of operation, however, has been effectively used by many surgeons

DePage,[7] in 1901, performed a gastrostomy which had, for its outstanding characteristic, a tube made from the anterior wall of the stomach in such a manner that it was lined with mucosa when completed This was effected

Submitted for publication August 16, 1937

by making a flap of the entire thickness of the stomach wall and converting this flap into a tube by bringing its two lateral cut edges together It was then carried to the skin surface and fixed so that only the opening of the tube was visible Beck and Carrell,[8] in 1905, Hirsch,[9] in 1911, and Janeway,[10] in 1913, each performed a gastrostomy with a tube which was lined with mucosa The mucosal lined tube did not become obliterated because no ad-

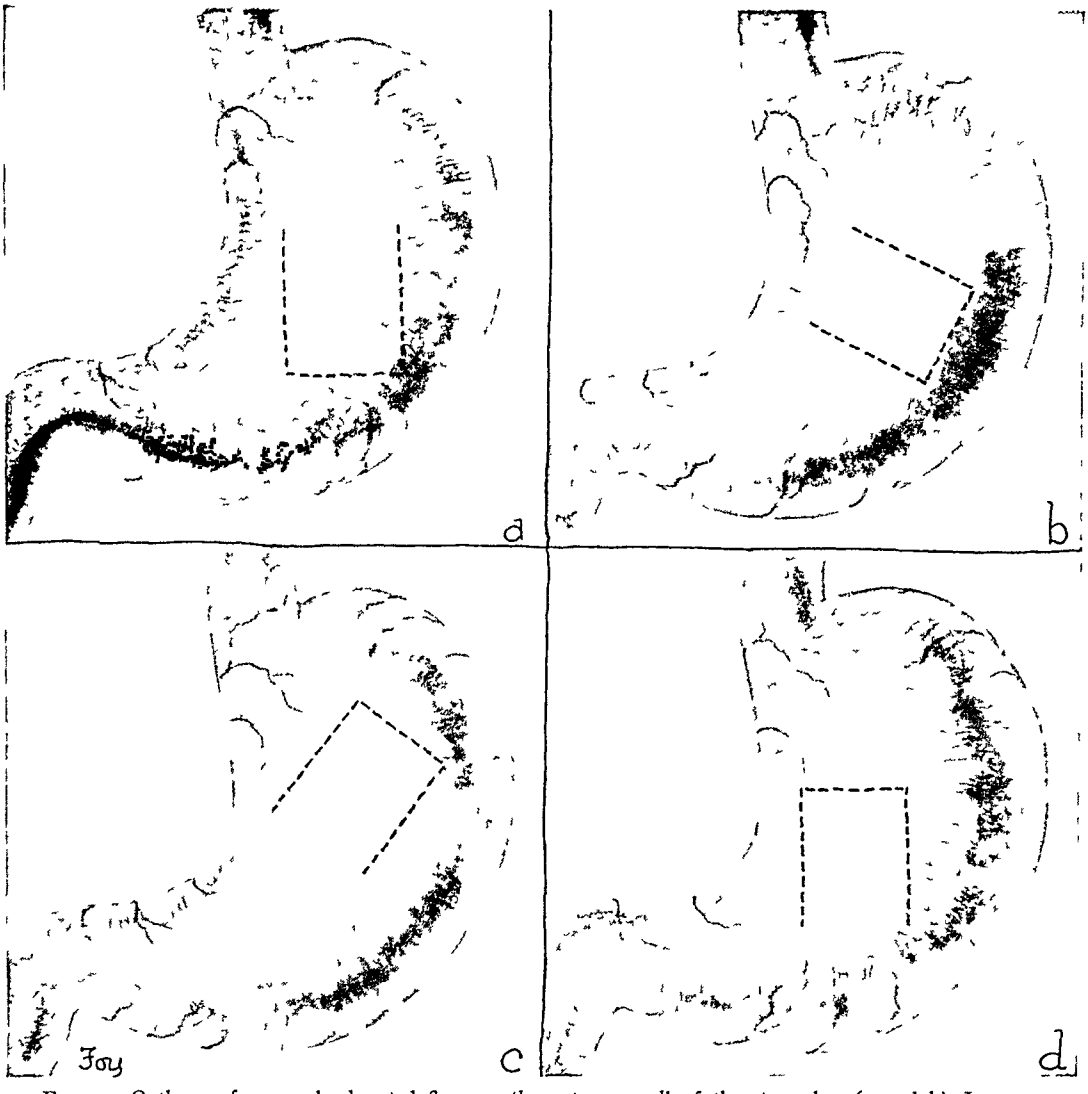


FIG 1 —Outlines of variously directed flaps on the anterior wall of the stomach (a and b) Janeway flaps (c) Hirsch flap, (d) DePage flap

hesions formed between the two apposed surfaces However, this type of gastrostomy, unfortunately, reintroduced the problem of leakage from the stoma The problem of maintaining an unobliterative mucosal lined tube and of preventing the leakage of gastric contents was effectively and ingeniously solved by Spivack,[11] in 1929 This was accomplished by forming a valve from the mucosa of the stomach which was placed at the base of the mucosal lined tube The valve allows food to be introduced into the stomach through

the mucosal lined tube and once inside, the stomach cannot return its contents past the valve As the intragastric pressure increases, the valve closes, once the valve is closed, a further increase in intragastric pressure tightens the valve

Sufficient time has now elapsed since the introduction of this method to judge its value and to determine its advantages and disadvantages It has

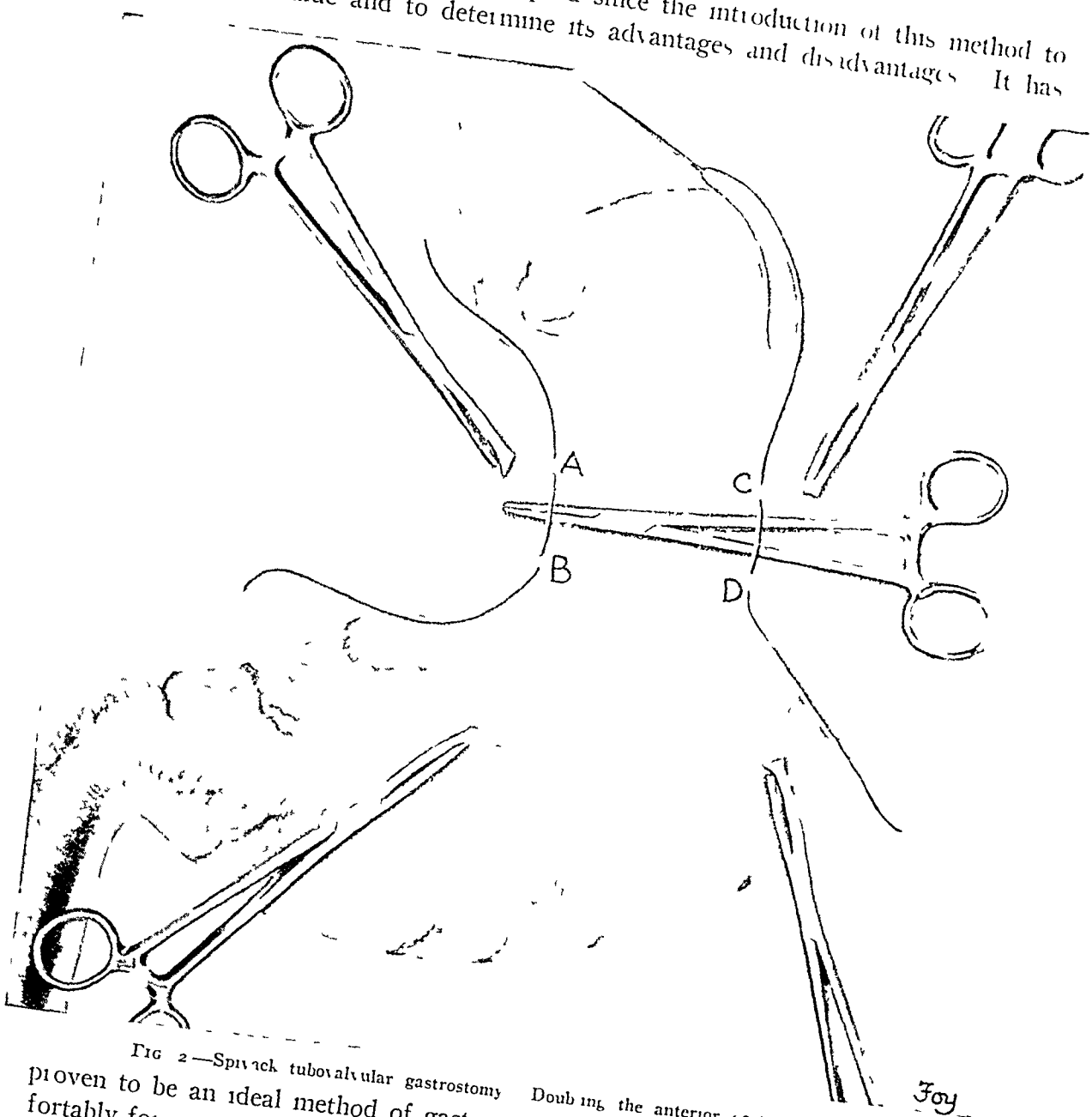


FIG 2—Spivack tuboovalvular gastrostomy Doubling the anterior gastric wall

proven to be an ideal method of gastrostomy, enabling patients to live comfortably for a period of weeks or months (in cases in which it was undertaken for carcinoma of the esophagus) and for years in those in whom it was performed for benign stricture of the esophagus It is the purpose of this article to present a series of patients operated upon by Dr Spivack and other surgeons using this method, pointing out the advantages, disadvantages, and pitfalls of the procedure

The first three cases upon whom Doctor Spivack performed gastrostomies were reported by Lowry and Sorenson,[12] and are included here as Cases 1, 2 and 3

CASE REPORTS

Case 1—The first patient operated upon had an aneurysm of the aorta which was compressing the esophagus The operation was performed under regional and splanchnic

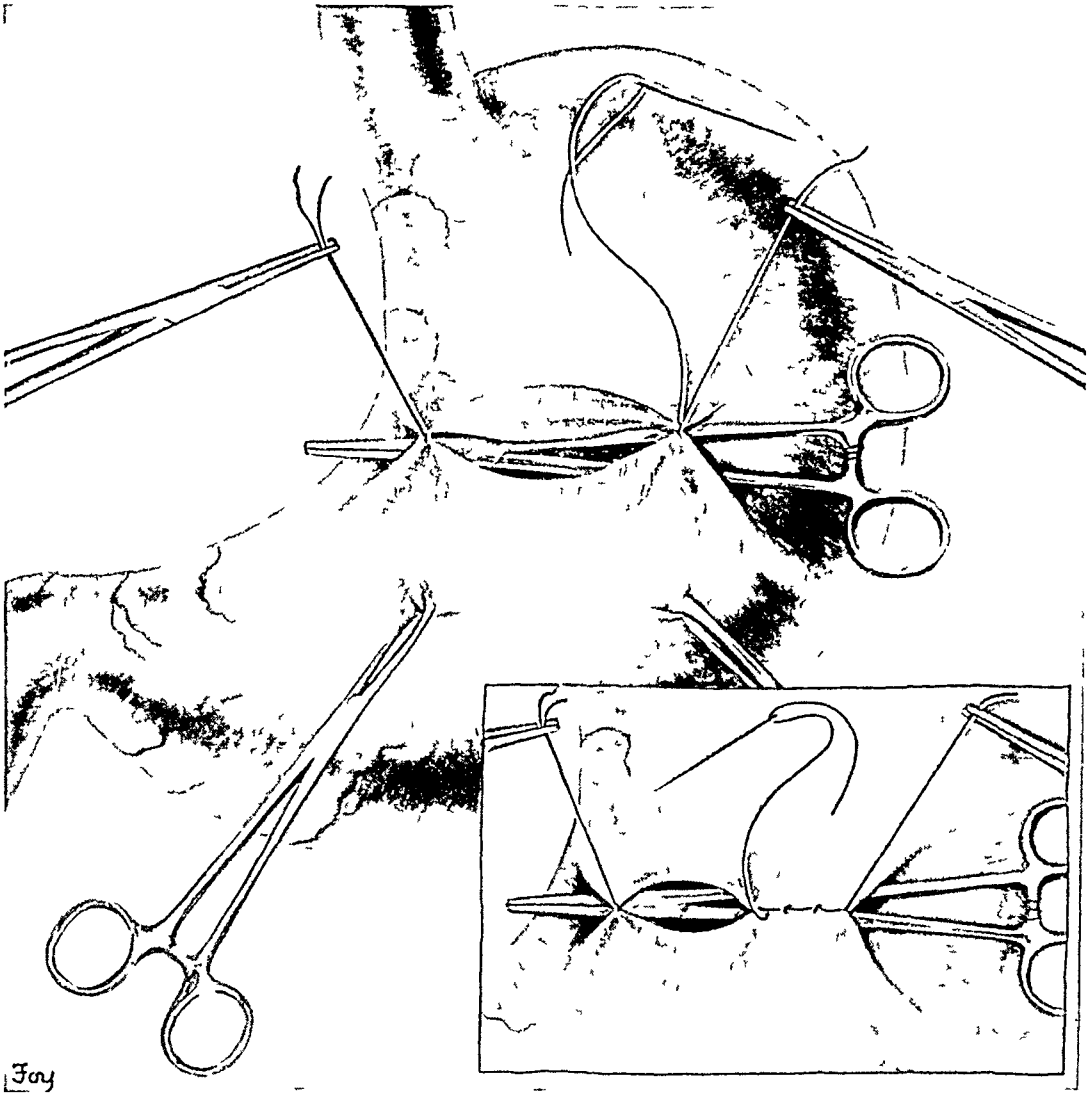


Fig 3—*A complementary illustration to Fig 2 showing the manner of completing the doubling of the anterior gastric wall*

anesthesia During the operation the patient vomited, but in spite of the fact that the stomach content was able to force its way through the compressed esophagus, it was unable to force its way out past the valve which had been made at the base of the tube in the tubovalvular gastrostomy This showed that the stomach was water-tight The patient died 16 days later from lobar pneumonia

Case 2—The second patient was operated upon for malignant stricture of the esophagus He was still living 18 months after the operation and quite comfortable, no leakage and no skin irritation were present For three of these 18 months he was able

to feed himself through the mouth and did not use the gastrostomy stoma but in spite of the fact that the gastrostomy tube was not opened for three months there was no change in its condition This proved that the mucosal lined channel leading to the stomach did not become obliterated

Case 3 —The third patient was operated upon for carcinoma of the cardiac end of the stomach She died 14 months later from general carcinomatosis Autopsy re

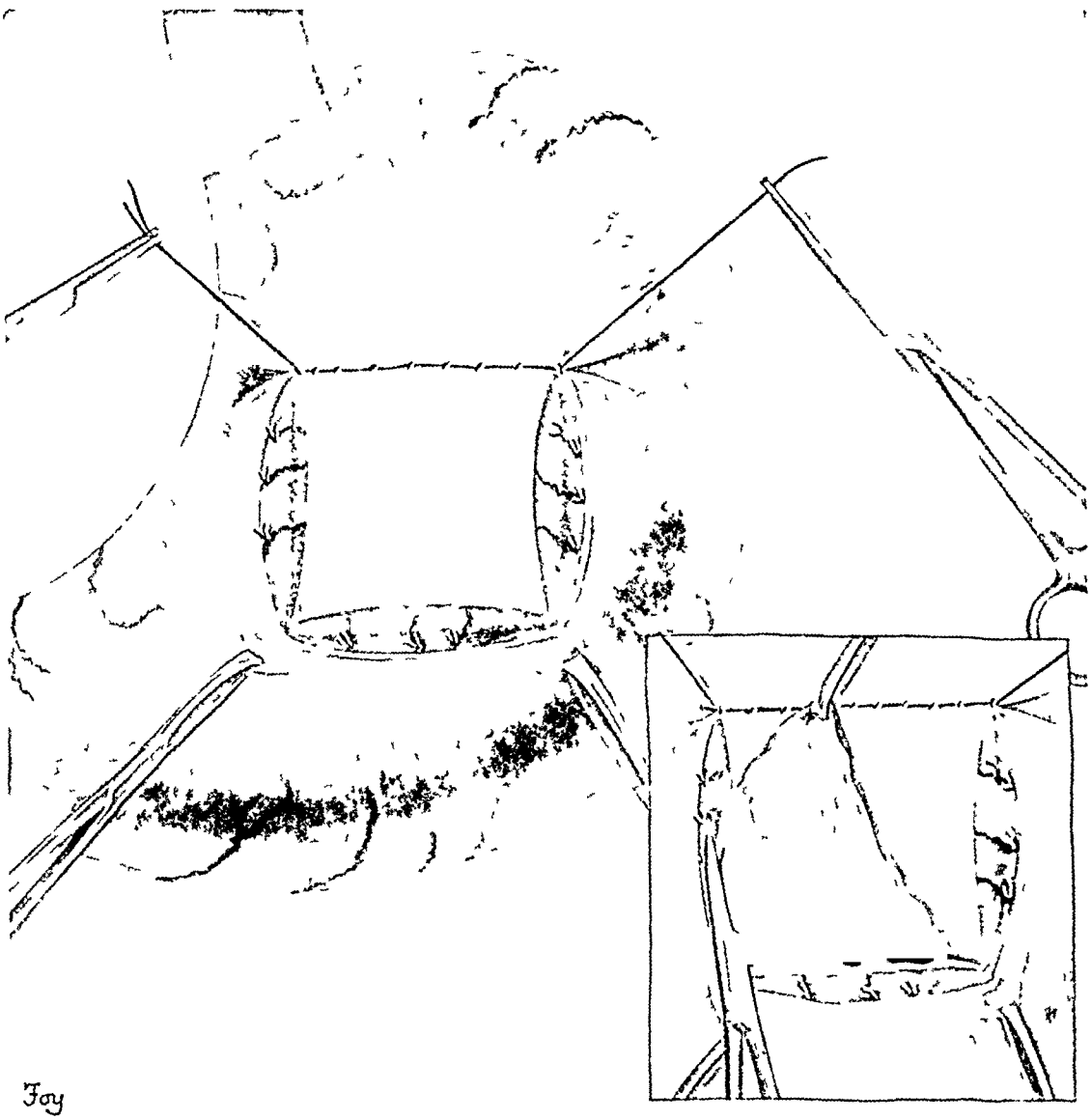


Fig 4 —Showing the completion of the seromuscular incision Insert illustrates the opening of the stomach

vealed that the whole stomach including the tube was involved in the carcinomatous process but the valve at the base of the tube was still intact and water-tight

Case 4 —In March, 1932, three years after the original description of the gastrostomy, Doctor Spivack operated upon a patient with carcinoma of the cardiac end of the stomach In this instance, the stomach was found to be very small and contracted, and after the valve had been made from the anterior wall of the stomach there was very little stomach wall left to be utilized for the formation of the tube In order to overcome this difficulty the gastrocolic ligament was cut through and the posterior wall

of the stomach was drawn up for a distance of one inch through this opening This permitted a satisfactory flap for the formation of the tube After the tube was formed, the gastrocolic ligament was replaced and resutured to the stomach The patient made an uneventful recovery and during the first three weeks gained 15 pounds He lived for nine months after the operation

Case 5—L M, a male, age 54, entered Cook County Hospital in September, 1934, with symptoms of dysphagia, vomiting, pain in the chest, and cough Blood pres-

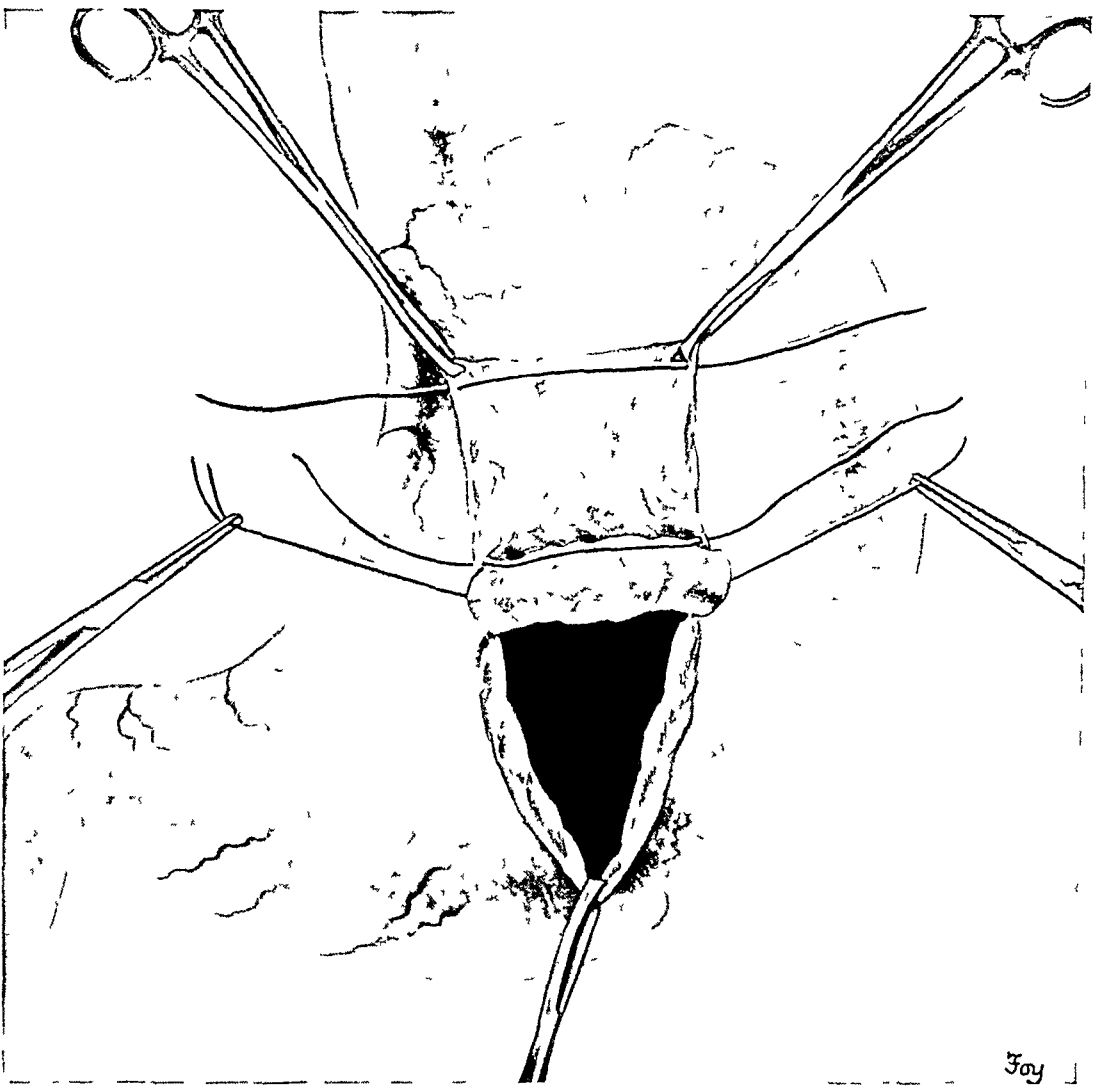


FIG 5—Showing the valve being exposed and the beginning of the construction of the tube

sure was 144/100 Urine, negative Blood Wassermann, negative Roentgenologic examination showed a carcinoma in the middle third of the esophagus Esophagoscopy revealed a bleeding, cauliflower mass A Spivack gastrostomy was performed upon the patient September 14, 1934 A local infection occurred which cleared up satisfactorily and he was discharged from the hospital November 9, 1934, with the gastrostomy functioning well He was able to feed himself without difficulty He returned two months later, emaciated, because he was unable to introduce food through the gastrostomy stoma He gave a history of having lost a catheter through the gastrostomy opening, which was recovered in the stool several days later On a 2,500 calorie diet, in

the hospital he gained seven pounds in one month and was again discharged He lived until July, 1935, when he died of metastases, ten months from the time of operation, during which period the gastrostomy functioned well, without leakage obliteration or skin excoriation

Case 6.—P G, a female, age 39, entered Cook County Hospital in June, 1936 with a history of the ingestion of lye, four months prior to entrance, followed by progressive dysphagia and a loss of 40 pounds Physical examination revealed an extremely

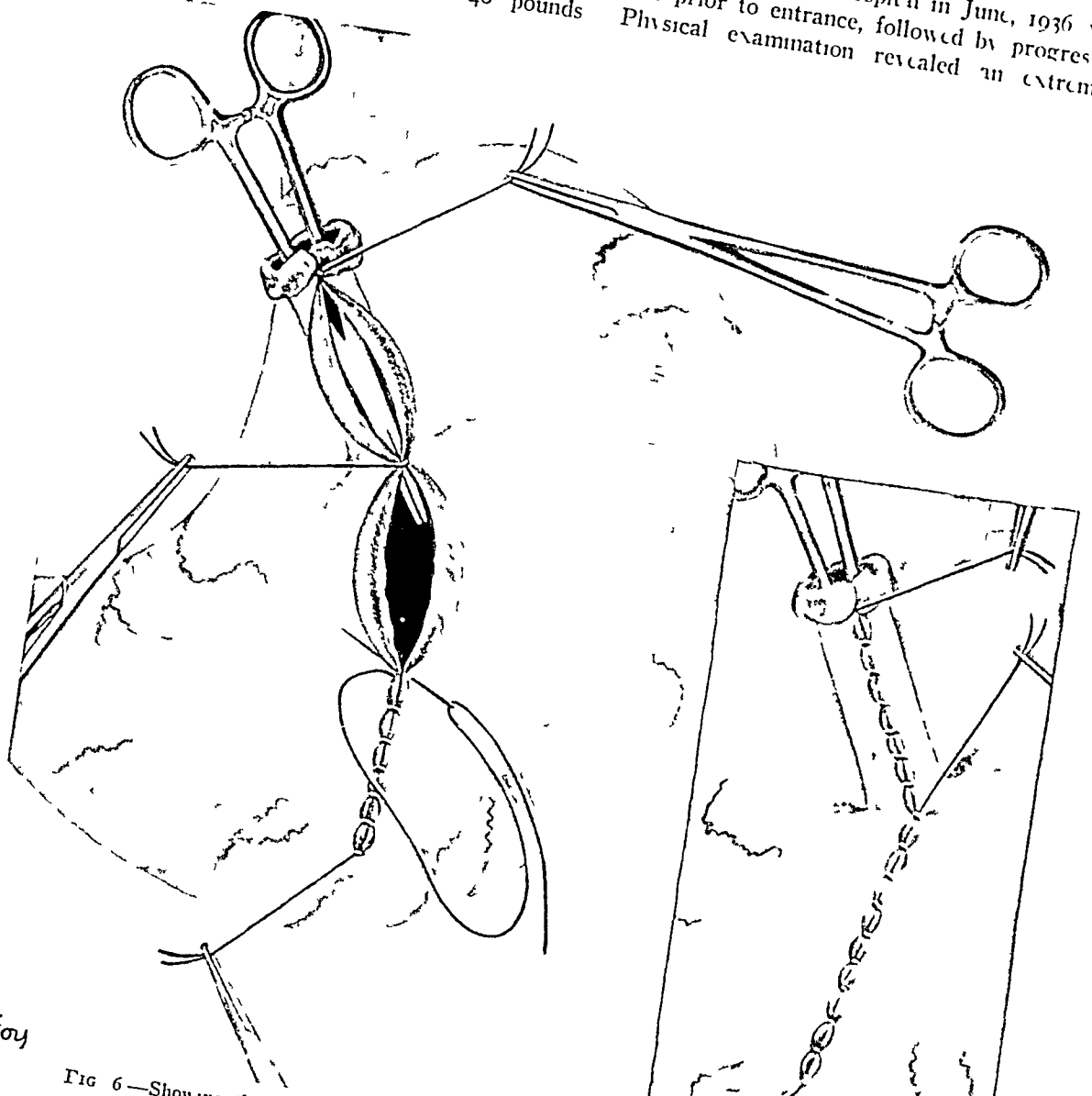


Fig 6.—Showing the suturing of the tube and the closure of the opening in the stomach

emaciated female Urine, negative Blood Wassermann, negative Roentgenologic examination revealed a stricture in the middle third of the esophagus A diagnosis of benign stricture of the esophagus, due to the ingestion of lye, was made, and she was operated upon June 13, 1936 A Spivack gastrostomy was performed She made an uneventful recovery and left the hospital 17 days after the operation She is still alive, ten months after leaving the hospital She is able to feed herself, introducing the catheter only at mealtimes There is no leakage of gastric contents The gastrostomy opening is about the size of a ten cent piece, located in the left upper quadrant of the

abdomen It is moist and there is no sign of skin excoriation, or local infection, in spite of the extremely unsanitary surroundings in which she lives

Case 7—R R, female, age 51, was admitted to the Michael Reese Hospital February 10, 1937, with the history of having had a thyroidectomy performed in 1927, and again in 1931 at which time a malignancy of the thyroid was discovered Three months prior to entering the hospital the patient had had increasing difficulty in swallowing food and hoarseness was very marked Physical examination showed three masses in the

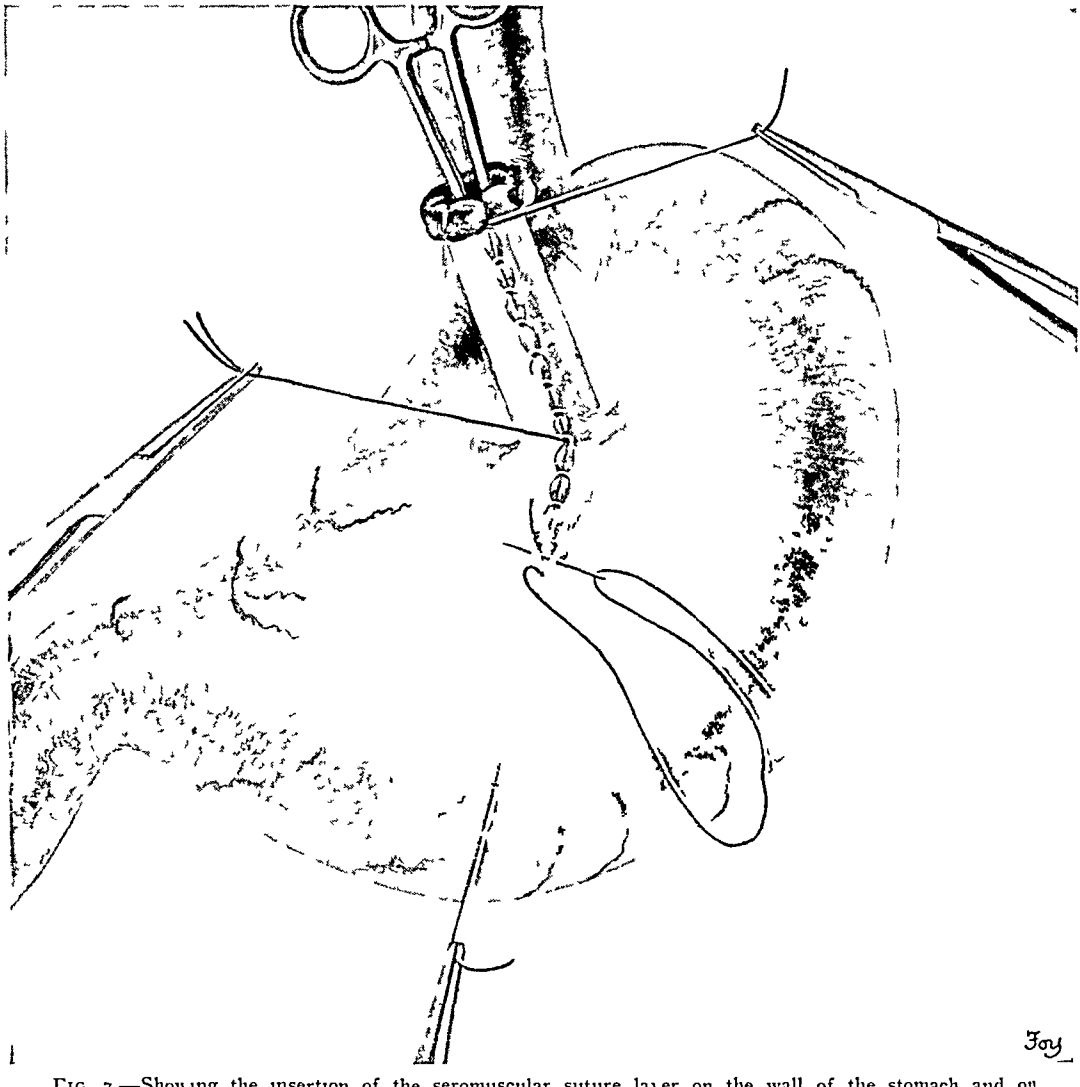


FIG 7—Showing the insertion of the seromuscular suture layer on the wall of the stomach and on the tube

neck, matted together, in front of the sternomastoid muscle Direct laryngoscopy revealed a subglottic submucosal mass protruding into the trachea On February 25, 1937, because of the dysphagia, a Spivack gastrostomy was performed On March 5, 1937, the gastrostomy was working perfectly The patient was receiving a high caloric diet through the tube and gaining weight She was discharged March 24, 1937, with a good functioning gastrostomy

Case 8—R B, a female child, age two and one-half, entered Cook County Hospital in March, 1936, and gave a history of having had whooping cough four months prior to her entrance Three months prior to entrance she had swallowed a pin which was

coughed up shortly after swallowing it Vomiting increased as the whooping cough subsided and continued to the time of entrance She had lost considerable weight and was very much emaciated when first seen A benign stricture of the esophagus was diagnosed and a Spivack gastrostomy was performed April 10, 1936 She had an uneventful recovery and gained weight rapidly on a high caloric diet, administered through the gastrostomy opening She is alive and well, one year after the operation

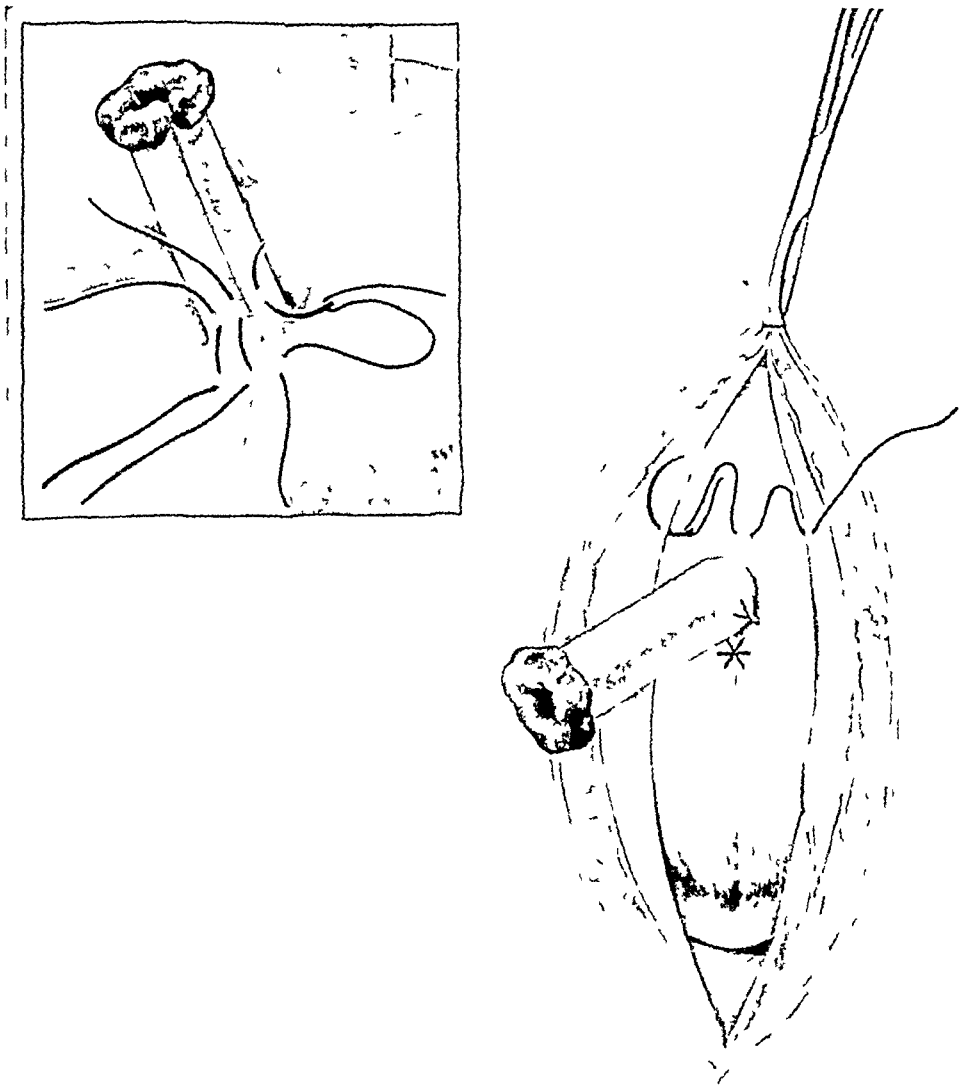


Fig 8—Showing the suturing of the stomach to the parietal peritoneum Insert illustrates the making of a cuff around the base of the tube

There is no leakage of gastric contents, no obliteration of the tube and no skin excoriation The gastrostomy opening is easily cared for by the nurses, requiring only a small dressing between feedings, and she is fed, readily, by the introduction of a catheter at mealtimes She is being kept at the hospital for the purpose of dilating the stricture of the esophagus

The value of using the Spivack type of gastrostomy as a preliminary operation to esophageal dilatation, or other operations, has been frequently stressed The following cases illustrate this point

Case 9—J G, a male, age 67, entered Cook County Hospital in June, 1935, with a history of dysphagia, vomiting, abdominal pain, and a loss of 40 pounds over a period of eight months The physical examination showed only extreme emaciation and epigastric tenderness Blood Wassermann, negative Urine, negative The stool showed gross blood Roentgenologic examination revealed a stricture at the lower third of the esophagus due to carcinoma A thoracic exploration was decided upon and, on June 11, 1935, a preliminary Spivack gastrostomy was performed The patient was easily

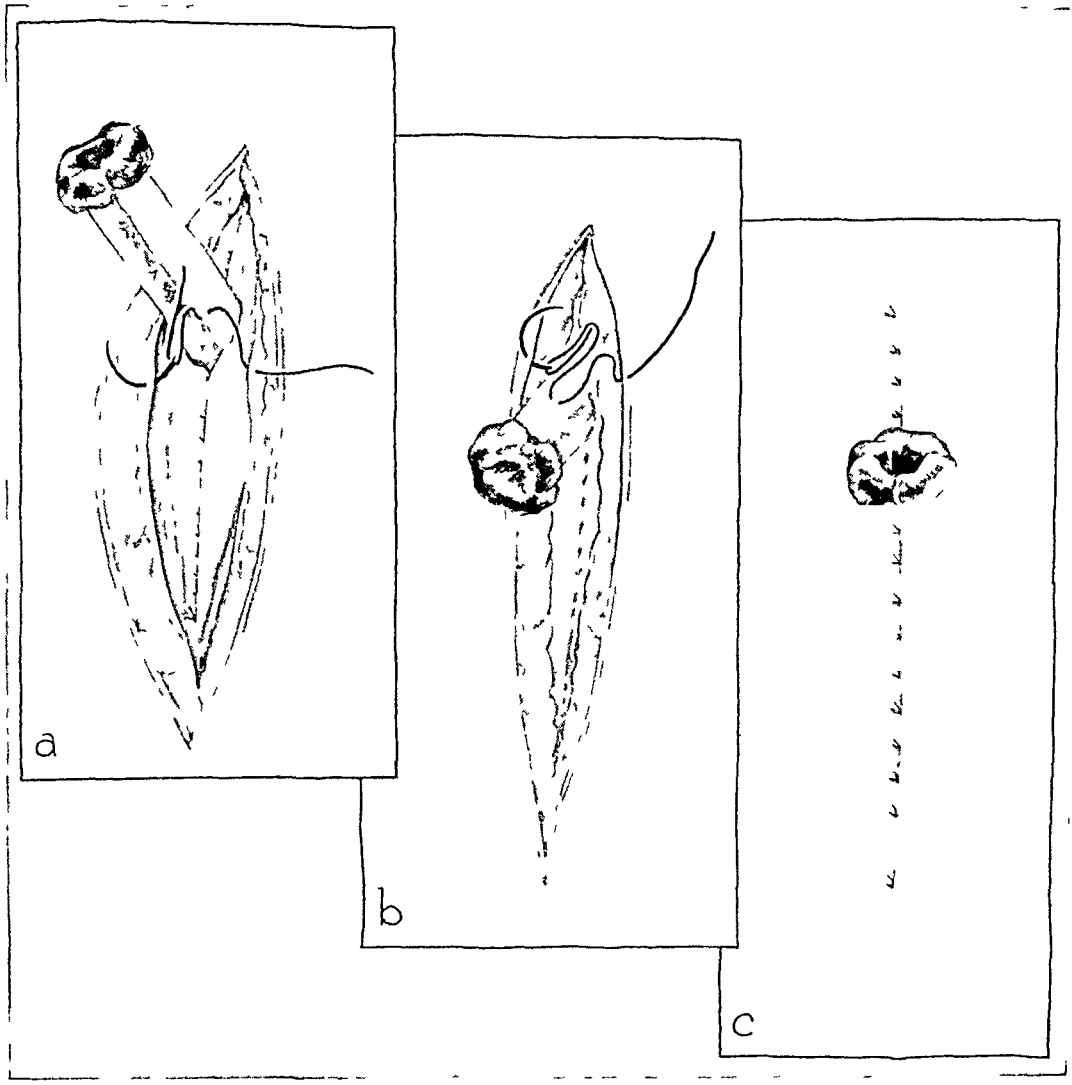


FIG 9—Showing (a) The suturing of the anterior sheath to the tube (b) The suturing of the subcuticular layer to the tube (c) Final appearance

fed and gained weight rapidly, so that a thoracic exploration was possible 27 days after the gastrostomy However, the patient was unable to survive the thoracic exploration and expired the following day

Case 10—J M, a male, age 52, entered Cook County Hospital with a history of dysphagia, vomiting, and a loss of 49 pounds over a period of four months The physical examination showed extreme emaciation Red blood count, 4,200,000 The urine showed a trace of albumin Blood Wassermann, negative Roentgenologic examination revealed a stricture of the middle third of the esophagus due to carcinoma

A Spivack gastrostomy was performed February 19, 1936 Following the operation the top of the artificially made tube became infected and part of it sloughed away on the fifth postoperative day One month later, the gastrostomy was satisfactorily healed and functioning well in spite of the absence of the upper end of the tube The patient was able to feed himself There was no leakage of gastric contents He returned May 23, 1936, complaining that the opening had become so contricted that he was unable

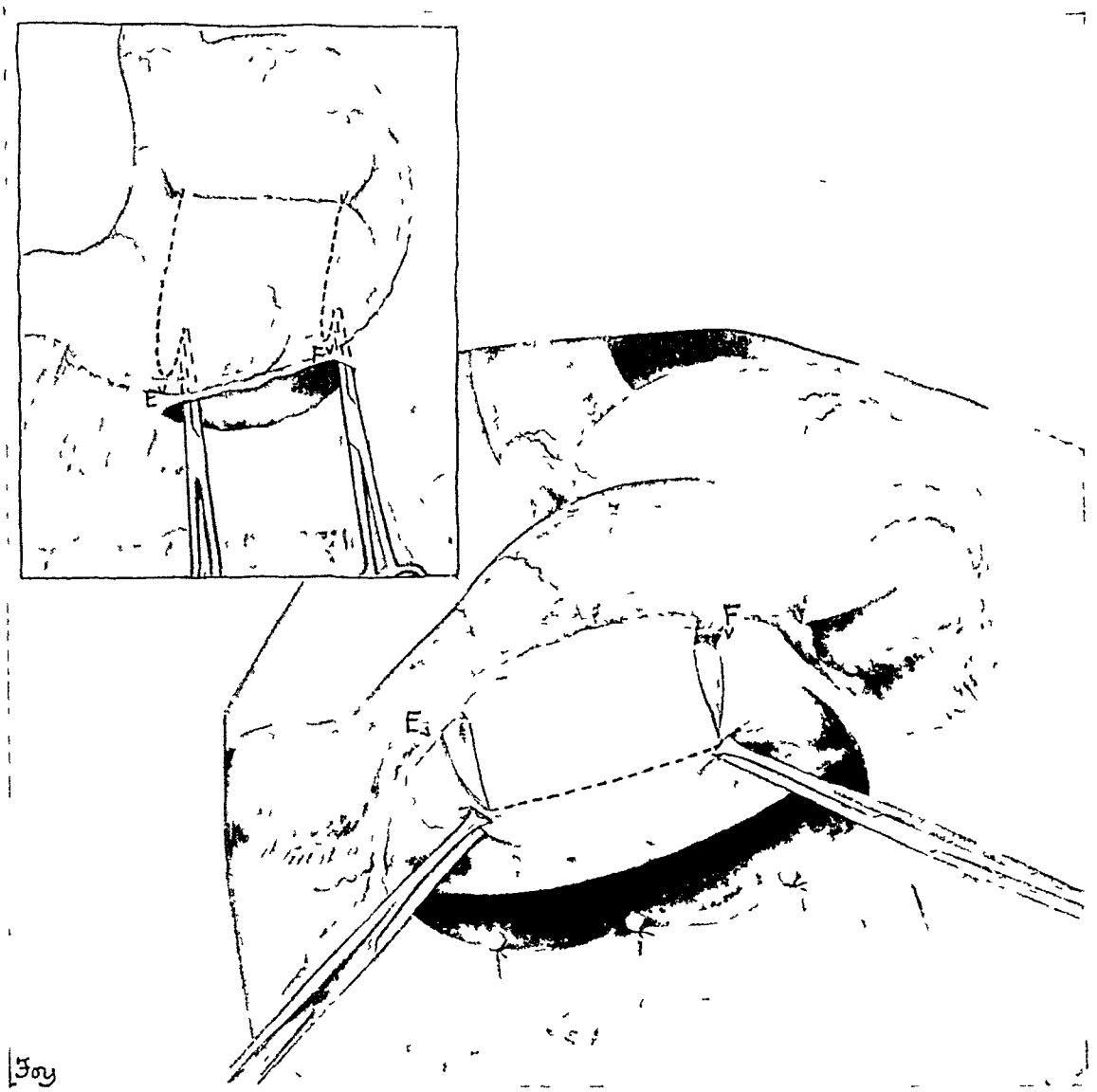


FIG 10.—Showing the utilization of a part of the posterior stomach wall in those cases in which the stomach is small and contracted

to feed himself A catheter was passed into the stoma, which was easily dilated and continued to function The patient lived for 12 months

This case demonstrates the danger of infection or gangrene of the tube It also demonstrates, once more, the effectiveness of the water-tight valve present at the base of the tube The tube may be partially sloughed away and still not greatly interfere with the function of the gastrostomy Spivack demonstrated the effectiveness of this valve by performing a complete gastrectomy

upon a dog upon whom the gastrostomy operation had previously been performed The esophageal and pyloric openings of the excised stomach were carefully closed and the stomach was then distended with water The gastrostomy tube was cut off just distal to the valve and the stomach turned upside down, but no water leaked out past the valve Considerable pressure was made on the distended stomach but the valve still prevented water from escaping

The reliability of the valve is made use of when it is desired to use the gastrostomy as a temporary opening into the stomach or when it is necessary for some reason to close the gastrostomy opening When the gastrostomy is no longer of any use, it may be closed by simply freeing the tube from the skin and surrounding fascia, cutting off the excess part of the tube above the valve and then closing the open tube by sutures The valve still remains intact and prevents the formation of a diverticulum of the stomach

The following case demonstrates the successful closure of the gastrostomy opening following leakage

Case 11—J N, a male, entered Cook County Hospital in September, 1934, because of dysphagia and loss of weight caused by a carcinoma of the lower third of the esophagus A Spivack gastrostomy was performed September 7, 1934 During the postoperative course the gastrostomy opening retracted beneath the skin but in spite of this he was able to feed himself with a catheter, and was discharged from the hospital with a good functioning gastrostomy on the nineteenth postoperative day He returned two months later stating that he was able to take fluids by mouth but that the stoma leaked The gastrostomy tube was dissected free, part of it was cut off, and the remainder was closed by suture The patient made a satisfactory recovery and had no more leakage of gastric contents

Case 12—A J, a male, age 58, entered Cook County Hospital with the complaint of dysphagia for one month Roentgenologic examination showed a constricting malignancy at the middle third of the esophagus An esophagoscopic examination showed a fungating mass A Spivack gastrostomy was performed and a catheter introduced at the time of operation which was not removed During the first fifteen days postoperative there was constant leakage from the tube around the catheter The catheter was then removed, but leakage continued

The procedure of leaving a catheter in the mucosal lined tube at the time of operation defeats the very purpose of the operation There is a valve at the base of the tube which can be opened only by pressure from above Pressure from below, *i e*, from inside the stomach, closes the valve A catheter left in the tube makes pressure on the valve from above and keeps it constantly open Leakage of stomach contents naturally then occurs around the catheter After the catheter remains in place several days, necrosis may occur around it because of pressure The valve itself then becomes ineffective The originator of the operation has repeatedly warned against this procedure

Case 13—E W, a female, age 58, entered Michael Reese Hospital, November 23, 1935, with a history of inability to swallow anything but liquids for four months Physical examination showed a mass above the sternal notch the size of a marble, firm and freely movable The esophagoscopic examination showed a fungating growth present on the posterior wall of the pharynx at the level of the cricoid cartilage A biopsy showed it to be a squamous cell carcinoma Radium therapy improved her condition for a time,

but, in September, 1936, a gastrostomy was found to be necessary in order to permit her to obtain sufficient food to sustain life On September 4, 1936, at operation, a small atrophied stomach presented itself A Stamm gastrostomy was performed She was discharged September 18, 1936, but returned, November 14, 1936, with sufficient dyspnea to necessitate a tracheotomy At this time she remained in the hospital and the following notes are taken from the hospital record

1–4–37—Gastrostomy leaking around the tube

1–17–37—Still leaking around tube, soaking dressings

1–21–37—Pezzer catheter introduced and clamped

1–31–37—Catheter slips out often Opening is larger and leakage is occurring

2–14–37—Advise closing present gastrostomy and making a Spivack tubovalvular gastrostomy

3–18–37—Spivack gastrostomy performed

3–26–37—Gastrostomy working perfectly

4–13–37—Gastrostomy functioning well Discharged

This case demonstrates the possibility of replacing a nonfunctioning gastrostomy with a Spivack type of gastrostomy which is water-tight and prevents further leakage This may be accomplished, as it was in this case, even on a small stomach

The success of the operation depends upon a careful attention to the details of technic The technic is so clearly explained in Spivack's "Surgical Technic of Abdominal Operations"[3] that it is repeated here verbatim

"In this operation a tube and valve are formed from a flap of the anterior wall of the stomach (Fig 1A, B, C, D)

"Step 1 A quadrangular area is outlined, in any direction, on the anterior wall of the stomach, three inches long and two inches wide (Fig 1) An Allis forceps is placed at each angle of this quadrangular area (Fig 2) (It should be emphasized here that although Spivack made his flap as a reversed U (∩), nevertheless, this is not an essential feature of his method)

'Step 2 A seromuscular suture is made between the points A and B, and C and D (Fig 2) The distance between A and B, or C and D, is from one to one and one-third inches An artery forceps is placed behind the threads connecting A with B and C with D The ends of the thread which connects A with B are tied and clamped The ends of the thread which connects C with D are also tied, and an artery forceps is placed on one end of the thread and with the other end of the thread on the needle the next step is performed (Fig 3)

"Step 3 The two ridges thus formed are sutured together by a continuous seromuscular suture (Fig 3) Thus, the upper half of the flap is doubled The artery forceps, or probe, lying behind the bridge is now withdrawn

"Step 4 Two seromuscular vertical incisions connecting the points A-B and C-D with the lower angles of the quadrangular area are made, and also a transverse incision connecting these lower angles with each other (Fig 4) In order to prevent the contraction of the seromuscular layer while making the transverse incision, each lower angle of the flap is caught by an Allis forceps before the transverse incision is made If large blood vessels are

seen on the mucous membrane they may be ligated before the mucosa is opened We prefer to ligate only the blood vessels which lie close to the stomach wall and not those which are close to the flap Still, if desired, they all may be ligated before the mucosa is incised (Fig 4)

"Step 5 The exposed mucosa is cut and the flap reflected A valve at the base of the flap is then clearly seen (Fig 5) Two buttonhole sutures are then made, one penetrating the upper two corners of the flap, and the other passing through two points at the base of the flap (Fig 5) The ends of both are tied and clamped The lower angle of the stomach incision is grasped by an Allis forceps (Fig 5) The ends of the two previously made sutures, which are the beginning and the end of the seromuscular suture, which connected the ridges to each other, are now cut short

"Step 6 An artery forceps is inserted into the stomach through the tube thus formed The opening into the stomach is closed by an over-and-over suture, as are also the lips of the tube When the first layer is completed it is reenforced by a second seromuscular layer (Figs 6 and 7)

"Step 7 The weak spot at the junction of the suture line of the tube with that of the stomach is now reenforced by three interrupted seromuscular sutures (Fig 8)

"Step 8 The anterior wall of the stomach is sutured to the parietal peritoneum A bite is taken on the parietal peritoneum and the posterior sheath of the rectus muscle of one lip, then through the seromuscular layer of the stomach at a point just below and proximal to the base of the tube and then through the peritoneum and transversalis fascia of the other lip, and the ends are tied The same is done to connect the peritoneum and the transversalis fascia of one lip with the stomach at a point lying below and distal to the base of the tube and then with the peritoneum and the transversalis fascia of the second lip Before tying the thread, care should be taken to see that the tube is not constricted (Fig 8) The rest of the peritoneal cavity is then closed in the usual manner

"Step 9 The wall of the tube is then sutured to the muscles and to the fascia in the same manner as described in Step 8 (Fig 9A)

"Step 10 The skin is attached to the tube in four places (Fig 9B) The sutures penetrate the subcuticular layer of one lip of the skin and then the seromuscular layer of the wall of the tube at a distance about half an inch from its open end, so that a portion of the tube will protrude above the surface of the skin, thus eliminating the danger of retraction of the mouth of the tube below the skin surface The mucosa covers the portion of the tube which protrudes above the skin in the form of a rosette (Fig 9C), thus preventing the harmful action of the air upon the serous layer of the protruding portion of the tube"

A tube is thus formed, which is lined with mucosa and therefore, the canal will not become obliterated The valve at the base of the tube assures the water-tightness of the stomach

Being confronted with a case of a very small and contracted stomach Spivack modified his usual technic in the following manner

"Step 3 The crests of the two ridges were united by a continuous seromuscular suture The gastrocolic ligament was cut between the points E and F, and part of the posterior wall of the stomach was drawn out (Fig 10) The gastro-epiploic artery (or arteries) were ligated between two ligatures at E and F (Fig 10)

"Steps 4, 5, 6 and 7 were performed as described above

"Step 8 The gastrocolic ligament was sutured to the stomach at the places where it was cut in Step 3 (Fig 10) In this variation the posterior wall is also utilized for making the tubovalvular gastrostomy"

This tubovalvular apparatus can be applied not only to the stomach but also to any hollow viscus such as the bladder, cecum, colon and jejunum

COMMENT —The advantages of Spivack's method of gastrostomy are manifested in the patients who lived for a considerable length of time with a functioning gastrostomy In these patients (1) There was no leakage of gastric contents with the accompanying disagreeable skin excoriations (2) There was no obliteration of the channel so that the patient could always be easily fed (3) The surgeon had no fear of a catheter being inadvertently pulled out by the patient, or attendant, immediately after the operation with the accompanying difficulty and danger of reinserting it (4) The patient had no need to keep a catheter in his abdomen constantly, with its accompanying discomfort All that was needed was to place the catheter into the stomach at the time of feeding (5) The patients could feed themselves easily, without the assistance of a medical attendant, so that constant care was unnecessary (6) The stoma was small and the mucosa was moist, permitting easy management, with a simple small dressing applied over it (7) The gastrostomy could be used as a temporary procedure for preparing the patient preliminary to other operations, after which it could be simply and easily closed under local anesthesia

Most of the disadvantages of the operation are not inherent faults of the operation, but are due to pitfalls which may occur as a result of improper execution of the technical details

These pitfalls are that

(1) The stomach may not be absolutely water-tight if the size of the valve at the base of the tube is too small To obtain the correct sized valve, careful attention must be paid to the flap selected from the anterior wall of the stomach The flap should be three inches long and two inches wide At least one and one-third inches of the available three inches of the flap should be used for the formation of the valve, *i e*, the part of the flap from which the valve is formed should be slightly less than one-half of the entire flap Failure to respect this point will result in an unsatisfactory valve In some cases the anterior stomach wall is too small for a satisfactory flap but in

these instances, it has been shown that part of the posterior stomach wall may be used in addition to the anterior wall (Fig 10)

(2) While sewing across the flap for the purpose of making the valve, there is a tendency to infold an increasingly greater amount of the remainder of the flap This results in the remainder of the flap becoming shorter on one end than on the other When the tube, which is made from this irregular flap, is finished, it will be found to be deformed This error is obviated by carefully sewing in a straight line across the flap one and one-third inches from the top

(3) Part of the tube may become gangrenous and slough away This may be due to one of two causes First, there may be an insufficient blood supply to the flap Studying each stomach individually before carrying out the making of the flap, with attention to assuring the pedicle of the flap with an adequate blood supply, should eliminate this difficulty Second, the tube may be constructed by suturing it too tightly between the layers of the anterior abdominal wall

(4) Leakage is possible at the point where the suture line on the stomach meets the suture line on the tube Cases have been reported in which leakage occurred at this point The originator has never met with this complication in any of his cases, in order to overcome it he considers it necessary to carefully invaginate the base of the tube by making a "cuff" around it as is described in the technic (Step 7)

(5) Retraction of the stoma of the tube below the surface of the skin may occur unless the tube is separately sutured to the different layers of the anterior abdominal wall

(6) Before closing the anterior abdominal wall it is important to suture the stomach to the peritoneum Adhesions between the stomach and peritoneum then form, and the weight of the stomach is not carried by the tube If this is not done, the weight of the stomach may exert sufficient pull to cause a rupture of the line of suture near the valve Another advantage of suturing the stomach to the peritoneum is that it makes all later manipulations around the tube extraperitoneal procedures and greatly diminishes the possibility of peritonitis

(7) The mucosa of the distal end of the tube should always overlap the serosa for at least one-fourth inch so that a rosette will be formed In this way the serosa will not be exposed to the air and it will not dry The exposed mucosa does not secrete sufficient gastric juice to cause skin excoriations but it always keeps moist

(8) To prevent the spilling of gastric contents, as the catheter is pulled out of the tube, a gauze should be placed around the tube at each feeding

(9) Spivack's gastrostomy can in most instances be performed under local anesthesia In view of this consideration, the fact that it takes longer to perform than the generally accepted gastrostomies (Stamm, Witzel, Kader) is not regarded as a disadvantage

(10) To avoid injury to the newly changed structures, no food should

be given via the tube for two days On the third postoperative day two ounces of liquid food every three hours may be administered through the tube On the fourth day the feedings may be increased to four ounces every three hours On the fifth day food may be added as tolerated If there is distention, a catheter may be momentarily introduced into the stomach for purpose of decompression

SUMMARY

(1) The advantages, disadvantages, and pitfalls of a gastrostomy described by Spivack are discussed

(2) Thirteen cases are reviewed to show the application of the gastrostomy to different problems in stomach surgery

(3) It is pointed out that the tubovalvular apparatus is applicable not only to the stomach but to any hollow viscus such as the bladder cecum, colon, and jejunum

REFERENCES

[1] Jones, S Gastrostomy for Stricture (Cancerous) of Esophagus Death from Bronchitis 40 Days After Operation Lancet, 1, 678, 1875
[2] Moynihan, Sir B Abdominal Operations W B Saunders & Co, 1, 422, 1926
[3] Spivack J L The Surgical Technic of Abdominal Operations Debour, 303–319, 1936
[4] Witzel, O Zur Technick der Magen-Fistelanlegung Zentralbl f Chir, 18, 601–604, 1891
[5] Stamm, M Gastrostomy by a New Method Med News, 65, 324–326 1894
[6] Kader, B Zur Technick der Gastrostomie Zentralbl f Chir, 23, 665–670, 1896
[7] DePage, A Noveau procede pour la Gastrostomie Jour de Chir et Annales de la societe belge de chirurgie, 1, 715–718, 1901
[8] Beck, C, and Carrell, A Demonstration of Specimens Illustrating a Method of Formation of a Prethoracic Esophagus Ill Med Jour, 7, 463–464, May, 1905
[9] Hirsch, M Plastischer ersatz des Esophagus aus dem Magen Zentralbl f Chir, 38, 1561, 1564, 1911
[10] Janeway, H H Eine neue Gastrostomie methode Munch med Wchnschr, 60, 1705–1707, 1913
[11] Spivack, J L Eine neue methode der Gastrostomie Bruns Beitr z klin Chir, 147, 308–318, 1929
[12] Lowry, N H, and Sorenson, S Spivack's Method of Gastrostomy Am Jour Surg, 18, 521–528, 1932

ENDOMETRIOSIS OF THE RECTUM AND SIGMOID

REVIEW OF THE LITERATURE AND CASE REPORT

JAMES D SCHOFIELD, M D , AND HARRY E BACON, M D

PHILADELPHIA, PA

FROM THE PROCTOLOGIC DEPARTMENT OF THE GRADUATE HOSPITAL UNIVERSITY OF PENNSYLVANIA PHILADELPHIA PA

LARGELY because of its relative frequency and the peculiar physiologic syndrome which is so characteristic of this condition, endometriosis of the sigmoid and rectum is of unusual interest Specifically, the term "endometrioSIS" is a misnomer, since it implies that the growth is a true blastoma, for which there is little supportive evidence Disregarding, however, this fundamental meaning, the appellation has come to be commonly accepted as designating a tumor containing aberrant endometrium or tissue resembling endometrium, which responds to the same stimuli which affect normal endometrium A combination of these endometriomata, better designated endometrial tumors,[31] constitutes a progressive disease referred to by Sampson[37] as endometriosis Other terms applied to this condition are adenomyoma, adenomyosis[11] and peritonitis adenoides[44]

Endometriosis occurs sufficiently frequently to be included among the more important benign lesions of the rectum and sigmoid Sampson,[36] as reported in a recent article, found endometriosis 101 times in 474 gynecologic operations, and Green-Armytage[14] recorded an incidence of 8 9 per cent in a series of 1,000 consecutive surgical cases

Endometriosis is almost exclusively a disease of women in the child-bearing age The vast majority are seen between the thirtieth year and the menopause, although cases have been reported as early as 11,[40] and as late as 72[11 44] Most instances have occurred in white women Various structures may be involved by this process, the more important of which are the ovaries, uterus, tubes, uterine ligaments, portions of the intestine such as the small bowel, appendix, cecum, sigmoid, and rectum, the peritoneum, omentum, bladder, the pouch of Douglas or rectovaginal septum, vagina, vulva, cervix, femoral and inguinal canals, umbilicus, and abdominal wall

Probably the most plausible theory is that promulgated by Sampson,[38] known as "transtubal implantation" He contends that particles of endometrial tissue or tubal mucosa are detached and regurgitated with the menstrual blood to become implanted upon a site that is especially susceptible, such as the ovary or pelvic peritoneum These implants tend to produce endometrial or "chocolate cysts" in the ovary Ovarian endometriomata enlarge at the time of menstruation, fill with blood and rupture, so that their contents gravitate and implant themselves on adjacent structures, usually the posterior wall of the uterus and the anterior wall of the sigmoid, where they undergo secondary

* Read before the American Proctologic Society, Atlantic City, June, 1937 Submitted for publication October 15, 1937

growth Some investigators, however, argue against this hypothesis, in that it does not explain the presence of extraperitoneal implants such as those sometimes found in the rectovaginal septum, at the umbilicus and in the inguinal region The serosal theory[18] is based upon the fact that the entire epithelium of the female genital tract is derived from the celomic mesothelium, so that, as a result of chronic irritation or some similar process, the serosa may undergo metaplasia or revert to its primitive function Another theory is that endometriosis is the result of cellular metaplasia brought about by glandular dysfunction[2] It has also been suggested[22 46] that these tumors may develop in adult life from embryonic rests, from mullerian ducts or the wolffian body Still another belief is that they are diverticula of endometrium which invade the wall of the uterus and adherent structures Many other hypotheses have been offered, but may be dismissed as of no significant import

Heidler[15] classifies this condition into endometriosis interna, representing the presence of heterotopic uterine glands in the deeper muscular layers of the uterine and tubal wall, and endometriosis externa It is in this latter group that proctologists are especially interested, since involvement of the rectovaginal septum, rectum and sigmoid is the most frequent and important of all the external endometriomata

Inflammatory reaction with fibrosis and adhesions is, according to MacLean,[26] characteristic The most common site of endometrial implants is where the peritoneum is folded irregularly Those of sufficient consequence to demand consideration are on the antimesenteric border of the sigmoid, at the attachments of the epiploic appendices and in the culdesac of Douglas In the majority of cases these implants present themselves as one or more firm nodules varying in size from a buckshot to a cherry, and situated in the rectovaginal septum or culdesac of Douglas Ordinarily they are slightly movable They seldom attain large proportions, although instances have been reported where the growth was noted as a single, ill-defined mass which was of sufficient size to cause obstruction One feature that is quite characteristic of endometriosis is that the mucosa of the rectum is rarely involved, as evidenced by its being freely movable over the tumor or tumors This explains why ulceration seldom occurs and bleeding is infrequently mentioned

Following involvement of the rectovaginal septum, the disease process may become diffuse, invade the muscular coat of the rectum and cause subsequent narrowing of the lumen As pointed out by Oehlecker,[31] two forms of stenosis of the rectum and sigmoid have been encountered (1) The long-shaped constriction of the rectum together with a rectovaginal endometriosis, and (2) the later form which is fixed merely to the sigmoid flexure and has no relation to the genital organs

Involvement of the sigmoid, according to Cullen,[9] is secondary to endometriosis of the rectovaginal septum On the sigmoid the endometrial or adenomyxomatous tumors are of smaller size and occur as tarry cysts or raspberry-like elevations A marked degree of puckering and scarring is noted which simulates that produced by a scirrhous carcinoma Where stricture

exists it will be found hard and annular in type, yet usually the mucosa is uninvolved It has been mentioned that the adhesions in patients with transplanted endometrial tissue are almost pathognomonic in that they are quite firm and rigid [6] Like all endometrial tumors, they tend to enlarge slowly, are capable of invasion and metastasis, but are curable It should be mentioned that malignancy has developed from an endometriosis situated in the rectovaginal septum [40 45] In one case metastasis to the lung was noted [24]

On pathologic examination, sections show the presence of gland ducts extending beneath the mucosa into the muscular layer The glands are lined with a single layer of typical endometrial epithelium, while outside the gland is a thin zone of endometrial stroma Varying amounts of fibrous tissue are noted between the smooth muscle fibers Ordinarily the mucosa is unchanged although scattered areas of atrophy are noted

The rectovaginal septum is the most common site of extra-abdominal endometriosis In a series of 576 patients with adenomyoma affecting 689 organs, Masson[27] found the rectovaginal septum involved in 20 instances, and the sigmoid in 14 Polsten[34] collected 90 cases and Keene[20] six, in a series of 118 Other instances of endometrial involvement of the rectovaginal septum, rectum and sigmoid have been reported [4 5 7 8 10 12 13 17 19 21 23 26 28 29 30 32 33 35 42 43 47]

In a general way, it may be said that the symptoms of endometriosis are similar to those of chronic inflammation without the infection and suppuration [3] Although they vary according to the size and extent of the growth, in almost every case they are increased in intensity at the time of menstruation Usually, a history of progressive constipation over a period of months or years is obtained In a few instances the constipation becomes so obstinate in type that when the patient seeks advice a partial obstruction is found Pain in the rectum is more or less a constant feature and is described as a dull, aching discomfort, intensified by defecation and especially severe during the menstrual period

Attention has been called to the fact that the symptoms tend to become worse and more prolonged each month, in those cases in which no treatment has been instituted [29] Dyspareunia, dysuria and pain over the sacral region are not uncommon, but bleeding is infrequent Diarrhea may occur, but is unusual Sterility has been cited in 30 to 40 per cent of all cases observed Dull abdominal pain in the left lower quadrant is usually present where the sigmoid is involved

A history of rectal pain in a female during the years of ovarian activity that is constantly accentuated and is progressive at each menstrual period and which does not entail rectal bleeding, is highly suggestive of endometrial invasion of the rectum or rectovaginal septum In the presence of the same symptoms, together with progressive constipation and left lower abdominal pain, involvement of the sigmoid must be suspected Digital examination elicits one or more firm nodules in the septum that are usually exquisitely tender, not fixed, with the overlying mucosa movable and intact Stricture of the sigmoid

due to endometrial implantation is usually not complete in its circumference It is of annular type and hard, with much puckering, but the mucosa usually appears normal Through the abdomen, sigmoidal endometriosis may be inferred by the presence of "chocolate cysts' adherent to its surface, which when removed, reveal areas of puckering A positive diagnosis can be made only by microscopic examination

The treatment of endometriosis of the rectovaginal septum, rectum and sigmoid is essentially surgical, although radium or roentgenotherapy may be employed Except where the rectal or sigmoidal growth is very large or a

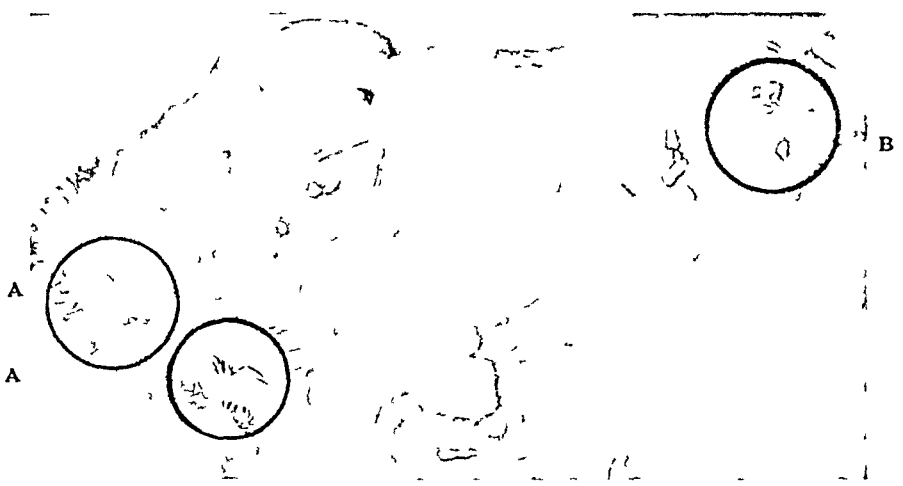


FIG 1 —Endometriosis of the sigmoid Low power ×10 showing general topography of the much thickened intestine with the normal mucosa along the lower border Several groups of epithelial lined spaces may be seen lying in the submucosa (A) and also deep in the thickened wall particularly in the upper portion of the section (B)

stricture is present, the safest and simplest procedure is to remove all ovarian tissue, following which the growth will regress and symptoms disappear Lockyer[25] reports good results after total hysterectomy and bilateral oophorectomy, with entire regression of the rectal tumor Colostomy is indicated where the growth threatens to cause obstruction Under such circumstances, an ideal procedure is to give the patient a temporary colostomy, perform bilateral ovariectomy, or restore the normal continuity of the bowel Where the sigmoid is involved resection may be necessary, but removal of the tumor by an elliptic incision with transverse suture of the bowel and omental graft, as suggested by MacLean,[26] seems a very practical procedure Instances have been recorded where endometriosis of the rectovaginal septum has disappeared under the influence of roentgen or radium therapy or a combination of the two [1, 16, 29, 41]

Case Report —A white female, age 36, was admitted to the hospital June 24, 1934 because of bleeding The family and personal history were irrelevant, other than that the patient stated that she has had a straw colored vaginal discharge for three years Examination showed multiple uterine fibroids and a left salpingo-oophoritis to be present

Laboratory Data —Uranalysis Sp gr, 1 014, acid, albumin, negative, sugar, negative Microscopic Epithelia, mucous shreads, few pus cells Blood examination Leuko-

cytes, 4,400, hemoglobin, 12 2 Gm , red blood cells, 3,650,000 Wassermann and Kahn, negative, blood sugar, 142 mg

Operation—June 25, 1934 The uterus was delivered through a median abdominal incision, the left infundibulopelvic ligament was ligated and cut, and the right and left broad ligaments were ligated and uterine arteries ligated The uterus was amputated



FIG 2—Area A Endometriosis of the sigmoid High power (×100) (A) showing normal mucosa and submucosa in which a portion of the endometrioma is seen below Note the large glands lined with tall columnar epithelium surrounded by typical tunica propria similar to that in the uterus

at the cervix and the cervical canal cauterized with phenol and alcohol Raw areas were peritonealized with the bladder fold of peritoneum and the round ligaments sewed to the cervical stump A Mikulicz procedure was employed in dealing with the involved sigmoid which was mobilized and brought out through a stab incision on the left side

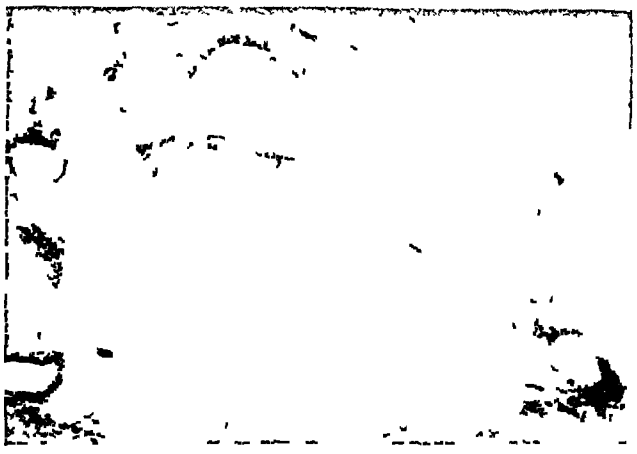


FIG 3—Area B High power (×150) showing the endometrioma deep in the thickened intestinal wall Note the typical tunica propria around the columnar lined glands

The parietal peritoneum was sewed to the visceral peritoneum, and the fascia and skin of both wounds closed anatomically The second stage operation was performed June 30, 1934 The patient was discharged August 23, 1934 General condition, good, wound on left side still draining

Operative Findings—Multiple fibroids of uterus, both tubes thickened and inflamed, left ovary sclerotic and cystic, appendix moderately inflamed, annular constricting mass

just above rectosigmoidal junction in the sigmoid, liver negative, no evidence of metastases

Pathologic Examination—Gross "Specimen consists of two pieces of tissue (A) An opened uterus 15 by 12 by 4 cm showing many fibroids, each cut open in different directions, making it impossible to orient the specimen Tubo-ovarian mass 7 by 5 by 2 5 cm Tube definitely thickened Ovary shows corpus luteum and small cystic spaces *Microscopic* examination of the ovary shows a formation of endometrial tissue Some fields are very typical The whole history corresponds to that of endometrioma (B) Specimen consists of a section of gut about 15 cm in length, opened longitudinally About the center of this section is a thickening of the wall which is not equal in all parts, in some places it is two to three times greater than in others The thickened portion is very firm and is more or less rigid under the knife *Microscopic* examination shows fair preservation of the normal condition of the mucosa but the rest of the wall is abnormal There is marked thickening due to nonstriped muscle and fibrous tissue in which are glandular formations and interstitial tissue which on the whole is rather typical of endometrium Some of these gland spaces are dilated and filled Pathologic Diagnosis Endometrioma of the sigmoid and ovary"

BIBLIOGRAPHY

[1] Albrecht, H The Comparative Value of Radical Operation of Irradiation as a Method of Treating Malignant Recto-uterine Endometriosis Arch f Gynak, 74, 155, December 1, 1933

[2] Allen, E A Clinical and Experimental Study of Endometriosis Am Jour Obstet and Gynec, 24, 803, 1933

[3] Bacon, H E Treatise on Diseases of the Anus, Rectum and Sigmoid Colon (Process of publication)

[4] Bartlett, R W Endometriosis of the Sigmoid Am Jour Surg, 29, 122, July 1, 1935

[5] Cattell, R B, and Swenton, N W Endometriosis with Particular Reference to Conservative Treatment New England Jour Med, 214, 341, February 20, 1936

[6] Crosson, A H Textbook of Gynecology, 2d ed, p 331 Philadelphia, W B Saunders Co, 1934

[7] Crossen, H S Clinical Features of Pelvic Endometrioses Jour Arkansas Med Soc, 29, 145, December 1, 1932

[8] Cullen, T S Adenomyoma of the Rectovaginal Septum Jour Amer Med Assn, 67, 239, August 1, 1916

[9] Cullen, T S Distribution of Adenomyomatas Containing Uterine Mucosa Arch Surg, 1, 215, 1920

[10] Eggers, C Endometriosis Disc Annals of Surgery, 102, 830, November, 1935

[11] Frankl, O Adenomyosis Uteri Am Jour Obstet and Gynec, 19, 680, November, 1925

[12] Friedman, L Perirectosigmoid Endometriosis Simulating Carcinoma Am Jour Surg, 33, 298, August, 1936

[13] Graves, W P The Treatment of Obstructing Rectovaginal Endometriosis Am Jour Obstet and Gynec, 13, 728, June, 1926

[14] Green-Armytage, V B Endometriomata, Five Clinical Types Brit Med Jour, 1, 602, April 8, 1933

[15] Heidler, R Clinical Aspects of Endometriosis Wiener klin Wchnschr, 47, 467, April, 1934

[16] Heineber, A Use of Radium in Treatment of Rectovaginal Endometriosis Am Jour Obstet and Gynec, 14, 235, August, 1927

[17] Hutchins, H T Endometriosis Disc Annals of Surgery, 102, 826, November, 1935

[18] Ivanoff, N S Monatschr f Geburtsh u Gynak, 7, 295, 1898

[19] Jessup, D S Adenomyoma of the Rectovaginal Septum J A M A, August 1, 1914

[20] Keene, F E Perforating Ovarian Cysts (Sampson) with Invasion of Bladder Wall Am Jour Obst, 10, 619, November, 1925
[21] Kliman, F E Endometriosis Minnesota Med, 14, 504, June, 1931
[2] Kossman, R Origin of the Glandular Inclusion in the Adenomyomas of the Uterus and Tubes Arch f Gynak, 54, 359, 1897
[23] Lochrane, C D Adenomyoma of Rectovaginal Septum Showing Decidual Reaction Proc Soc Med Sect Obst and Gynec, 15, 34, May, 1922
[24] Lockyer, C Adenomyoma, Dean Lewis' Practice Surg, Vol XI, Chap 18, p 16, W F Prior & Co, Hagerstown, 1936
[25] *Ibid* p 31
[6] MacLean, J N Endometriosis of the Large Bowel Jour Canadian Med Assn, 32, 253, 1936
[27] Masson, J C Surgical Significance of Endometriosis ANNALS OF SURGERY, 102, 821, November, 1935
[8] Meigs, J V Tumors of the Female Pelvic Organs, p 344, The Macmillan Co, N Y, 1934
[9] Mills, L M Endometrioma Involving the Rectum China Med Jour, 41, 338, April, 1927
[30] Mussey, R D Symptoms of Pelvic Endometriosis Amer Jour Surg, 30, 141, October, 1935
[11] Nicholson, C W Studies on Tumor Formations, Mixed Tumors Guy's Hosp Rep, 76, 188, April, 1928
[32] Novak, E Pelvic Endometriosis Amer Jour Obstet and Gynec, 22, 826, December, 1931
[33] Oehlecker, F Endometriosis of the Sigmoid Flexure and Rectum Zentralbl f chir, p 1264, May, 1932
[34] Polster, K O Heterotopic Proliferation with Structure of Uterine Mucosa Virchows Arch f Path anat, 96, 259, November, 1926
[35] Rosenloecher, K Anatomical and Clinical Experiences with 65 Cases of Endometriosis Arch f Gynak, 149, 439, 1932
[36] Sampson Quoted by Heidler [15]
[37] Sampson, J A Life History of Ovarian Hematomas Am Jour Obstet and Gynec, 4, 451, November, 1922
[38] Sampson, J A Perforating Hemorrhagic Cysts of the Ovary Their Importance and Especially Their Relation to Pelvic Adenomas of Endometrial Type, "Adenomyomas" of the Uterus, Rectovaginal Septum, Sigmoid, *etc* Arch Surg, 3, 245, September, 1921
[39] Seitz, L Die klinik der endometriosis Zentralbl f Gynak, 57, 1, January, 1933
[10] Seitz, L The Origin, Clinic and Therapy of Endometriosis (Adenomyosis) Munch med Wchnschr, 79, 741, May, 1932
[41] Schofield, J D Endometrioma Tr Amer Proc Soc, p 40, 1928
[42] Schofield, J D Endometriosis of the Large Bowel Disc Amer Med Assn Gastroenterol Soc, Atlantic City, June, 1935
[43] Stetson, H C Endometriosis New England Med Jour, 202, 52, January 14, 1932
[44] Tabler, T Frankfurt Ztschr f Path, 29, 558, 1923
[45] Thomson, A P Malignant Endometriosis with Metastasis to the Lungs Proc Roy Soc Med, 19, 16, 1926
[46] Von Recklinghausen, F D Die adenomyome und cystodenome der uterus and tubenwandung A Hirschwald, 1896
[47] Yeomans, F C Adenomyoma of the Rectum Tr Amer Proc Soc, p 60, 1918

EARLY CARDIAC DECOMPENSATION IN TRAUMATIC ARTERIOVENOUS ANEURYSMS*

JAMES M MASON, M D, GEORGE S GRAHAM, M D
BIRMINGHAM, ALA
AND
JASPER D BUSH, M D
DECATUR, ALA

WE HAVE recently had the unusual experience of observing a traumatic arteriovenous aneurysm of the third portion of the left subclavian vessels which ended fatally on the fourth day following a stab wound in the supraclavicular fossa The cause of death, as revealed by clinical observation and autopsy, was rapidly developing cardiac decompensation

From studies of a large number of arteriovenous fistulae resulting from wounds received during the World War, and confirmed by further study of cases in civil life throughout the world, it has been established that, in addition to the local and peripheral symptoms of arteriovenous aneurysms, cardiovascular degenerative changes regularly follow the production of arteriovenous fistulae between vessels of large caliber

It has been proven that the damage to the heart results from the shunting of large quantities of arterial blood into the venous channels through the fistulous opening, with consequent overfilling and dilatation of the right side of the heart Serious cardiac symptoms are looked upon as late manifestations of the deleterious effects of arteriovenous aneurysms, hence, the early appearance of decompensation and the rapidly fatal outcome in the case herewith reported were surprising

In discussing the case with Doctor Matas, he referred us to an article by Tixier and Arnulf,[1] entitled "Cardiac Accidents of Immediate Precocity in Traumatic Arteriovenous Aneurysms," who include, under this designation, the type of case in which severe cardiac symptoms appear within 15 days, reporting one personally observed instance, and giving abstracts of two others, one by Rochet and one by Stone

A careful review of the literature failed to locate other similar instances, that is to say, reports of cases in which early cardiac decompensation was the outstanding clinical feature The review did, however, reveal a case reported by Caraven,[2] where a combination of hematoma in the neck, dysphagia, dyspnea, and continuous thrill with systolic reinforcement, caused the author to operate on the fifth day, with immediately fatal result from hemorrhage and reflex disturbances attributed to the carotid sinus syndrome Tixier and Arnulf suggest that "One of the reasons why these early, immediate cardiac accidents are so rare is that in arteriovenous aneurysms which make very

*Read by Title before the American Surgical Association, at New York, N Y, June 3–5, 1937

large communications the patient often requires immediate operation to prevent death from hemorrhage In this stage it is difficult to assess which of the cardiac symptoms are due to traumatic shock and which to the establishment of the arteriovenous communication"

Likewise, too few cases of early cardiac decompensation have been reported to permit one to be dogmatic in the evaluation of dangerous symptoms In general, it may be said that the symptoms of early cardiac decompensation do not differ from those which develop late In those instances of which we have record, rapid pulse, dyspnea, cardiac murmurs and cardiac enlargement, together with rapid fall in blood pressure have been the outstanding symptoms

Great technical difficulties and extremely dangerous consequences attend early operations upon arteriovenous aneurysms, especially in such locations as the groin and the root of the neck Hence, when brought face-to-face with a cardiac accident of "immediate precocity," one must consider, on the one hand, the well recognized dangers of early interference, such as hemorrhage, infection and gangrene, and, on the other, the risk of death from rapid overfilling of the heart

Reid[3] has summed up the advantages of delayed operation as follows

"In some cases, hemorrhage, increasing hematoma, infection, and, *very rarely,* acute cardiac symptoms make it necessary to operate soon after the injury When none of the foregoing complications makes operation imperative, delay presents the following advantages

(1) A good collateral circulation develops which permits excision of the fistula without fear of gangrene
(2) The injured vessels become thoroughly healed, making their dissection easier and safer
(3) Infection is less likely to occur
(4) Spontaneous healing may take place"

In operating in the early period, while the aneurysm is in the hematoma stage, conservative operations on the involved artery designed to preserve its lumen will prove extremely difficult and probably impossible, especially if the wound is in a location where proximal and distal control of the circulation is difficult to obtain Multiple ligations on excision in this stage are likewise dangerous on account of the probability of gangrene of the part distal to the fistula

Early cardiac decompensation has been observed so infrequently that no definite rules of procedure have been established The dangers attending early radical operations have, however, stimulated thought as to safer methods which might be temporarily invoked to retard the progress of cardiac degeneration

In arteriovenous fistulae experimentally produced, Holman and Stultz found that, in some instances, cardiac lesions failed to develop either early or late This failure was attributed to the development of a thrombus in the

vein proximal to the fistula Organization of the clot prevented the reflux of blood toward the vena cava and dilatation of the right heart did not occur

Reasoning from this, it would appear that in the early stage, ligation of the vein proximal to the fistula might delay the development of cardiac decompensation until a favorable time for attempting radical cure of the arteriovenous aneurysm

Proximal Ligation of the Vein—Tixier and Arnulf[1] say "Theoretically, if we accept the experimental work of Holman and Stultz, it might be possible to begin by the application of a ligature on the vein some distance above the fistula The experiments of these authors show that by this simple procedure one may stop cardiac disorders Later one may treat the arteriovenous aneurysm *in the usual way*" But, they add "The lack of practical and clinical experience makes it impossible to judge the value of this procedure"

Doctor Matas,[4] likewise, comments favorably upon the possibilities of proximal ligation of the vein, and says "Precocious cardiac complications are important prognostically and surgically because they compel an early intervention before the collateral circulation has had time to assert itself They also modify the technic of the operation, because as yet the aneurysm has not emerged from the hematoma stage and the vessels and perivascular tissues have not fully recovered from the immediate effects of the trauma I believe that cases of precocious cardiopathy bear out the rule that they are always associated with large direct fistulae in the great trunks near the heart or at the root of the limbs *Quoting the suggestion of Holman and* Stultz, the ligation of the vein alone on the cardiac side of the fistula may suffice to stop the stream on the heart and permit a more complete operation at a later day when the collateral circulation is fully established"

Since cure of an arteriovenous fistula depends upon the complete and permanent closure of all abnormal communications between the arterial and venous systems, proximal ligation of the vein is not a curative measure and has no place in the early treatment of such a fistula if *undertaken for the control of* active bleeding or of slow hemorrhage manifested by an increasing hematoma

If undertaken for the relief of impending cardiac disaster, the experimental work of Holman and Stultz leads one to hope that it may be helpful This hope is strengthened in some degree by Stone's[5] clinical observation, that his patient's pulse showed immediate improvement when the vein was ligated, also by a case reported by Holman[6] in which "simple closure of the vein proximal to the fistula obliterated the thrill and caused the pulse to drop from between 108 and 112 to 84

The ligation should be performed at a level some distance above the fistula —so as not to invade the region of the hematoma with its attendant difficulties and dangers If proximal ligation is not followed by immediate improvement in heart action, the operator should be prepared, as Tixier and Arnulf have pointed out, to obliterate the fistula by multiple ligations or excision, leaving the question of peripheral gangrene for subsequent consideration

Case Report—Hillman Hospital, No 110217 A colored, male laborer, age 29, married, was stabbed in the left supraclavicular fossa at 11 P M, October 10, 1936, and was admitted to hospital at 2 30 A M, October 11, 1936 in grave shock Death occurred October 14, 1936, at 11 P M

Physical Examination revealed a stab wound over the outer third of the left clavicle The patient was treated for shock, and the wound was sutured Further examination revealed a pulsating swelling above and below the left clavicle which extended out towards the point of the shoulder Over this area there was a marked thrill and a continuous bruit with systolic accentuation The bruit was transmitted down the arm, over the upper aspect of the chest, anteriorly and posteriorly, and along the side of the neck

Examination of the heart Apex beat forceful It was visible in the fifth interspace at the nipple, and palpable 1 cm to the left of the nipple in the fifth interspace Systolic murmurs were heard at the apex and at the second right and left interspaces There was an occasional extra systole The right radial pulse was much stronger than the left Blood pressure, right 154/54, left 114/54

The rest of the physical examination was essentially negative His previous history was irrelevant He denied luetic infection but had had two attacks of gonorrhea He smoked and used alcohol in moderation He had worked regularly up to the time of injury

Laboratory Data—Urine, 1,022, acid, albumen 400 mg, no sugar, no pus, no blood, no casts Blood, hemoglobin 63 per cent, red blood corpuscles 3,230,000, leukocytes, 10,900, large and small lymphocytes 25 per cent, polymorphonuclear leukocytes 75 per cent Kline test, plus 4

TABLE I

DAILY RANGE OF TEMPERATURE, PULSE AND BLOOD PRESSURE

Blood Pressure	Right	Left	Pulse	A M	P M
Oct 11	154/54	114/54		100	80
13	114/48	94/50		100	100
14	98/50	82/50		100	100
Temperature			Oct 11	97°	99°
			12	99°	99°
			13	99°	100°
			14	99 4°	99°

Respirations 20–26 throughout the illness

Roentgenologic examination of the chest—October 13, 1936 "Both lung fields clear The outline of the heart is rather unusual in that it is triangular in shape and has a straight left border" (Fig 1)

Clinical Course—When admitted three and one-half hours after the injury, the patient was in shock There were marked signs of cardiac impairment which, by negative autopsy findings, were thought not to have antedated the injury Blood examination showed 3,230,000 red cells and 63 per cent hemoglobin, hence it was concluded that the shock was out of proportion to the amount of blood lost before his admission There was no loss of blood, either internally or externally, after he reached the hospital

Fluoroscopic and roentgenologic examinations of the chest, made on the third day, revealed an enlarged heart, but there was no evidence of hydrothorax or hemothorax A teleroentgenogram was contemplated but death took place before this could be made

Thrill, bruit, and hemic murmurs persisted The great disparity in blood pressure on the two sides, and the promptness with which the left radial pulse lost strength and volume, demonstrated the rapidity of the return of blood to the heart through the fistula

During the four days which preceded his death, there was complaint of constant pain in the left chest and of dyspnea, there was a steady fall in systolic and diastolic blood pressure, the pulse rate ranged between 100 and 120, albumen appeared in the urine, the

respirations were shallow and ranged between 20 and 26 per minute At autopsy a right pleural effusion, approximately 400 cc in amount, was found There was no evidence of this on the third day, when the roentgenograms were made, and its presence at autopsy indicated that it had developed within the last 36 hours of his life

After the initial shock was overcome, the treatment consisted of rest, sedatives, and supportive measures for the heart, none of which were effectual

Autopsy—This was performed by Dr G S Graham upon the embalmed body, three days after death Externally, the only notable abnormality is a recently sutured, penetrating wound just above the outer third of the left clavicle It is about 2 cm in length, its margins clean and in an early stage of healing About 400 cc of clear serous fluid are

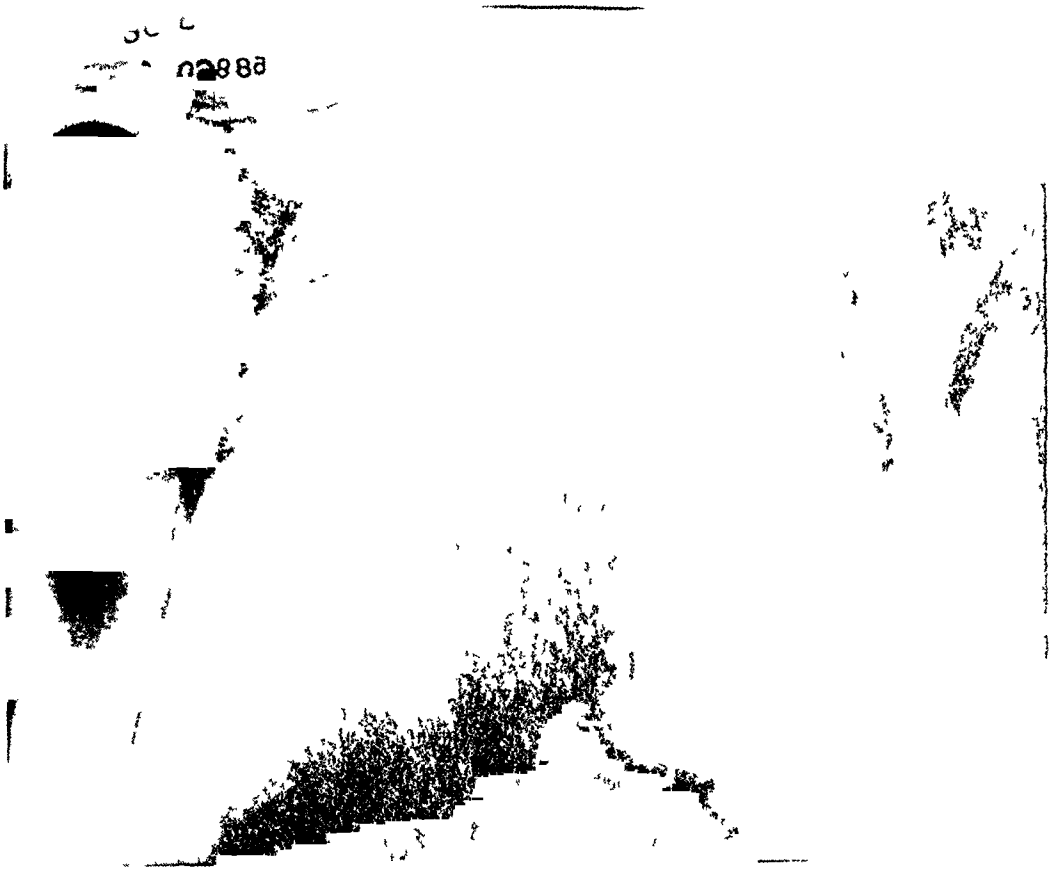


FIG 1—Roentgenogram of the chest taken 36 hours before death Note the enlarged triangular outline of the heart and the absence of any shadow denoting fluid in the pleural cavity

present in the right pleural cavity No gross changes are seen in the organs below the diaphragm

The heart and thoracic aorta together with the great vessels of the neck and the entire left subclavian artery and vein were removed en masse The tissues beneath and about the wound are suffused with blood, which extends downward and outward in and about the pectoral muscle mass to the axillary margin, and mesially in the muscle planes and connective tissue about half way to the sternal margin It also extended beneath the parietal pleura of the anterior chest wall to about the third rib The wound tract perforates the subclavian vein in its anterior and in its postero-inferior wall and opens the adjacent wall of the subclavian artery through an oval aperture measuring 4×3 Mm The anterior wound in the vein wall measures 5×6 Mm and is located 13 cm from the junction of the vein with the left innominate (Fig 2) A probe passes through it into the lumen of the artery (Fig 3) The posterior wound of the vein wall is larger It opens outward into a cavity in the apposed fibromuscular tissue that reaches a diameter of about 3 5 cm Its inner surface

is irregularly sacculated and trabeculated The cavity contains fresh and clotted blood and adherent to the wall are patches of laminated clot resembling those of a true aneurysm There is slight fusiform enlargement of the vein proximal to the wound The dilated segment is about 4 5 cm long and its wall is definitely thinned The diameter reaches 2 cm as compared with a diameter of 1 2 cm at the wound level

The heart is slightly enlarged It weighs 406 Gm The epicardium is smooth The myocardium is completely fixed by the embalming fluid, and its gross characters are obscured No scars nor other gross changes can be made out The valve measurements are Tricuspid 14 5 cm, pulmonary 8 3 cm, mitral 11 5 cm, aortic 8 0 cm

The wall of the right ventricle is 0 3 cm thick, the left ventricle 1 8 cm The right auricle is definitely enlarged, the other chambers are of normal size The valves and endocardium are smooth In the ascending arch of the aorta there is a large patch of

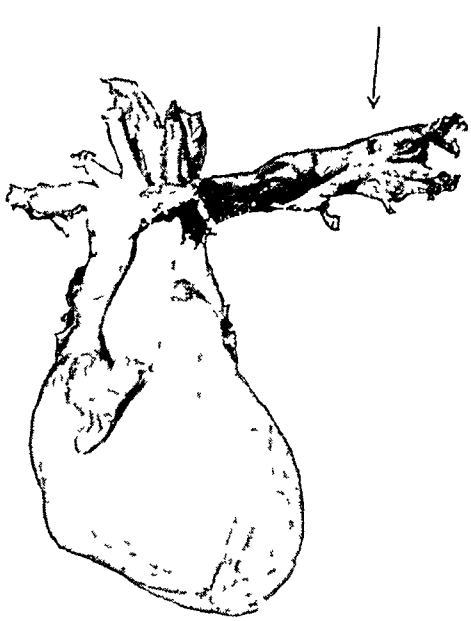


FIG 2 —Photograph of the heart and left subclavian vessels Arrow points to the wound in the subclavian vein



FIG 3 —Left subclavian artery incised showing the fistulous communication with the subclavian vein

thickening and scarring that begins at the valve level and encircles the wall in about three-fourths its circumference The process involves two of the aortic valve commissures where it produces a widening and thickening of the attachments The lesion envelops the orifice of the left coronary artery and narrows it The coronaries are otherwise free of gross changes

Anatomic Diagnosis —Stab wound above left clavicle producing traumatic arteriovenous fistula of left subclavian artery and vein False aneurysm at wound site Dilatation of right auricle of heart Slight cardiac hypertrophy Luetic aortitis

Sections taken at the wound site show, in the vessel walls, little leukocytic reaction to the injury Proliferating fibroblasts are gathering in the wall of the false aneurysm and a few lymphocytes are present here A laminated clot is already being built up within the aneurysmal cavity

In the heart, sections from the right auricle and ventricle show no recognizable changes in the musculature or coverings A block from the left ventricle shows, in the subendocardial zone, a layer of early necrosis of the muscle fibers with partial failure of the stain-

ing reaction of the nuclei and cytoplasm In the affected muscle and especially along its margins there is an infiltration of leukocytes, predominant among them are polymorphonuclears The small vessels are engorged and there is occasional suggestion of early thrombus formation Outside this zone the muscle is of normal appearance and the blood vessels are free of lesions

The lung shows generalized engorgement of the capillaries of the alveolar walls and a coagulated serous fluid filling most of the alveolar spaces Large numbers of "heart failure cells" are present There are scattered, minute areas of early leukocytic exudate

There is moderate venous engorgement in liver, spleen and kidney, otherwise there are no noteworthy changes found in the remaining organs

ABSTRACT OF REPORTED CASES

(1) Tixier and Arnulf[1]—Traumatic arteriovenous aneurysm of right femoral vessels in Scarpa's triangle following gunshot wound, November 16 1933

Marked cardiac decompensation on fifth day *Quadruple ligations and excision on ninth day* Prompt relief of cardiac decompensation Impairment of peripheral circulation followed with edema superficial gangrenous areas and contracture of foot in equinus to approximately 120 degrees These complications necessitated lumbar sympathectomy and tenotomy of the tendo Achillis in February and August, 1935 respectively, and gradual restoration of function

(2) Rocher, Surgical Society of Paris 1919—Aorta caval arteriovenous aneurysm from gun shot wound received in action 15 days before admission to hospital The patient was dyspneic and there was congestion at both lung bases The pulse was 120 There was a large diffuse mass behind the liver, over which could be detected a thrill, and a bruit which could be heard from the groin to the neck Hematuria was present A few days after admission there occurred a great fall in diastolic blood pressure Diagnosis of arteriovenous aneurysm between the aorta and renal vein was made because of the hematuria No operation was to be considered on account of the inaccessibility of the lesion and the desperate condition of the patient He died at the end of three months from progressive heart failure Autopsy showed that the arteriovenous communication was between the aorta and the vena cava

(3) Stone[5]—The patient had received a stab wound of the femoral vessels in left groin He was seen the day following the injury There was a large hematoma The pulse rate was 120 and scarcely perceptible at the wrist The patient was in a critical condition and immediate intervention was imperative The artery and vein were exposed above the point of injury Immediate improvement followed ligation of the vein, and the pulse dropped to 100 upon ligation of the artery Improvement was rapid and the patient made a complete recovery

(4) Caraven[2]—Carotid jugular fistula A man was shot through the neck five days previous to admission He was suffering from dysphagia and dyspnea there was an hematoma at the anterior edge of the left sternomastoid muscle over which a thrill and bruit with systolic accentuations could be heard In addition to the wounded vessels, the respiratory and digestive tracts had been injured The patient was operated upon at once Death occurred on the table from hemorrhage and from cardiac symptoms which the author attributed to carotid sinus reflexes

SUMMARY—The treatment employed and the results obtained in the five cases herein discussed were as follows

Our own case, left subclavian vessels, died on the fourth day without surgical interference

Caraven's[2] patient, carotid-jugular vessels complicated by injury to the trachea and esophagus, operation on fifth day, died on the table from hemorrhage and carotid sinus reflexes

Rocher's patient, aorta-caval fistula, died without surgical intervention at the end of three months

Tixier and Arnulf's[1] patient, femoral vessels at the groin, multiple ligations and excision on ninth day, cardiac decompensation arrested, prolonged

disability from impairment of the peripheral circulation which required secondary lumbar sympathectomy and tenotomy for relief

Stone's[5] patient, femoral vessels at the groin, multiple ligations on second day, complete recovery

CONCLUSIONS

In the imperfect state of our knowledge of this serious condition, due to the limited number of observations, it behooves us to give careful attention to the behavior of the heart in all cases of traumatic arteriovenous aneurysm of the larger vessels, and to exercise extreme conservatism in undertaking early operation

REFERENCES

[1] Tixier and Arnulf Accidents Cardiaques Immediats dans les Fistules Arterio-veineuses Traumatic Lyon Chir, 33, No 3, Mai–Juin, 1936

[2] Caraven A Propes des Aneurysmes Arterio-Veineux Bull et mem Soc nat de Chir, 54, 116–124, February 4, 1928

[3] Reid, Mont R Abnormal Arteriovenous Communications, Acquired and Congenital Arch Surg, 11, 237–254, 1925

[4] Matas, R Personal communication, November 18, 1936

[5] Stone, Harvey B Trans Southern Surgical Association, 44, 369, 1931

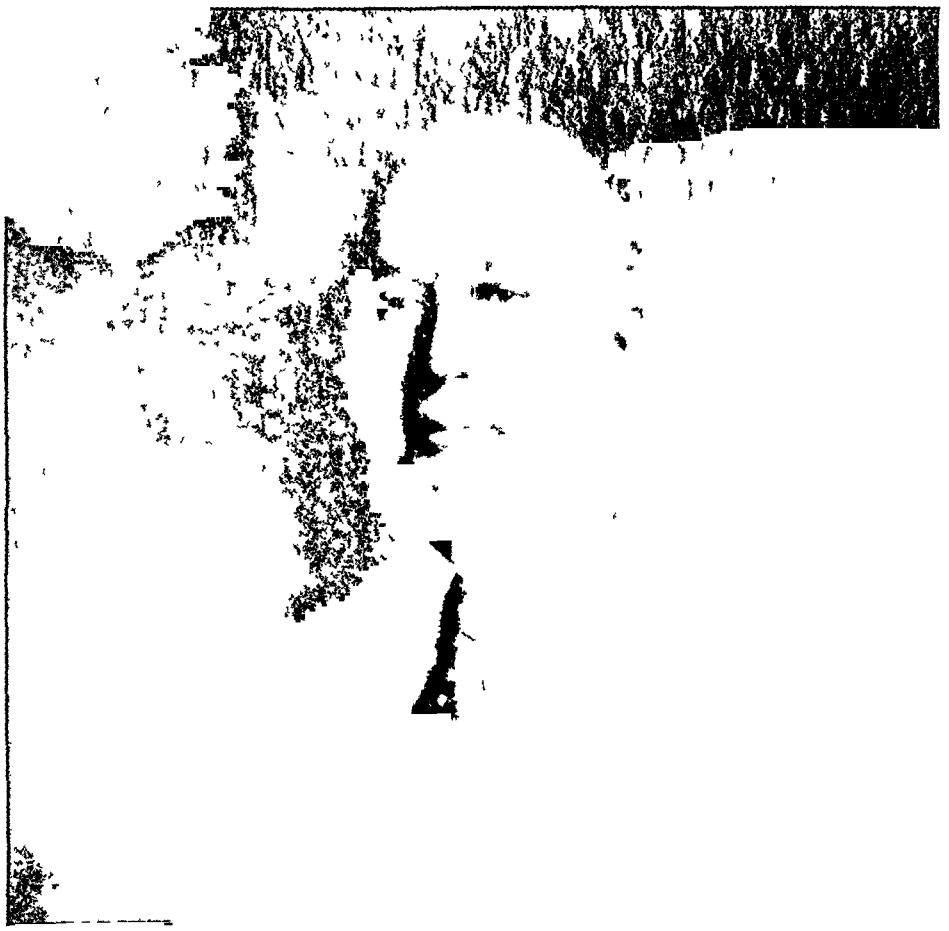
[6] Holman, Emile Arteriovenous Aneurysm Clinical Evidence Correlating Size of Fistula with Changes in the Heart and Proximal Vessels ANNALS OF SURGERY, 80, 801, December, 1924

MEMOIR

DANIEL FISKE JONES

1868–1937

DOCTOR JONES was born in Minneapolis, Minn., June 2, 1868, and died in Boston September 11, 1937. He received his preliminary education in the Minneapolis public schools and entered Harvard University at the age of 20, being graduated from this institution with an A.B. degree, in 1892, and an M.D. degree, in 1896. Following his surgical internship in the Massachusetts



DANIEL FISKE JONES, M.D.

General Hospital, he became associated with Dr. Maurice Howe Richardson as his private assistant. His long contact with Doctor Richardson was very pleasant as well as one which furnished ample opportunity to develop his surgical knowledge and skill.

In 1903, he was made surgeon to Out Patient in the Massachusetts General Hospital, and to this institution he was devoted throughout his active career,

gradually rising to chief of the East Surgical Service, in 1925, which position he held until the retirement age of 60 At the same time that he received this appointment to the Massachusetts General Hospital, he became an associate in surgery in the Harvard Medical School, which position he held until 1932

Doctor Jones was also interested in the New England Deaconess Hospital and was a member of the staff of that institution from 1898 until his death He was made surgeon of this institution, in 1923, and chief surgeon of the Palmer Memorial Hospital, associated with the Deaconess, in 1927

His war service started in 1916 when he went to France as Surgeon-in-Chief of the Harvard Surgical Unit in charge of the Twenty-second General Hospital of the British Engineering Forces In July, 1918, he became a major in the Medical Corps of the United States Army and went overseas a second time in October of that year He was discharged May 21, 1919, with the rank of Lieutenant-Colonel

Doctor Jones carried on one of the most extensive private practices of any individual that we know He never refused any call on his time Regardless of the status of the patient or his location, he was ever ready and willing to give his services—often at times when he should have been resting Few men have worked harder at their jobs than he Fortunately, he had a very strong physique and this made it possible for a great many sufferers to benefit through his endeavors He had unusual ability in diagnosing obscure lesions Being endowed with the type of mind that allowed him to combine the history of the patient, the laboratory data, and the physical findings, he arrived at the logical conclusion almost infallibly Technically, he was not spectacular but he had proper respect for tissue, a definite understanding of how much or how little an individual patient could stand, and his results were far above the average This made him an excellent teacher—not so much from the standpoint of the undergraduate as from that of the house officer and resident One could rarely find him operating without as many men in the stands as could be free at the moment, hoping to add to their own fund of knowledge from this great master He was particularly interested in surgery of the large bowel and developed the surgery of rectal cancer in an exceedingly competent and satisfactory manner His efforts in educating the profession in New England in the early diagnosis of cancer of the rectum are well substantiated when one considers that the operability of this lesion in the 25 years during which he was interested in it has increased from approximately 30 per cent to approximately 70 per cent Also, largely through his experience and teaching, the mortality from this operation has been reduced to approximately 10 per cent in the Massachusetts General Hospital

His chief recreation was the "big woods" and fishing, which he thoroughly enjoyed He traveled considerably but when at home his first love was his work He was never so happy as when a difficult surgical problem was being dealt with, and one must admit that his hobby was surgery This did not prevent him from having a host of friends among both the profession and the laity

Doctor Jones was a member of the American Surgical Association and was its president in 1933 He also belonged to the Southern Surgical Association the Society of Clinical Surgery, the Interurban Surgical Association, the New England Surgical Society, the American College of Surgeons, the Boston Surgical Society, and the Massachusetts Medical Society

He was a Regent of the American College of Surgeons from 1921 to 1923, and a member of the Board of Overseers of Harvard College from 1932 until his death He was on the Board of Trustees of the Boston Medical Library

In 1899, Doctor Jones married Mary Haughton Richardson of Brookline, Mass Mrs Jones and three children survive him One cannot help mentioning the perfect sympathy which his devoted wife had toward his work and the completely unselfish attitude which she assumed in this matter

We will sorely miss this devoted friend, this master surgeon, and this able teacher We are grateful for his long and useful life

ARTHUR W ALLEN

BOOKS RECEIVED

The receipt of books for review is hereby acknowledged This statement shall be regarded as sufficient acknowledgment of the courtesy of the publishers Selections will be made for review predicated upon the interests of the readers of the ANNALS OF SURGERY and as space permits

THE 1937 YEAR BOOK OF GENERAL THERAPEUTICS Edited by Bernard Fantus, M S, M D, and Samuel J Nichaman, M D, OBSTETRICS AND GYNECOLOGY Edited by Joseph B DeLee, M D, and J J Greenhill, M D, DERMATOLOGY AND SYPHILOLOGY Edited by Fred Wise and Marion B Sulzberger, M D, NEUROLOGY, PSYCHIATRY AND ENDOCRINOLOGY Edited by Hans H Reese, M D, Harry A Paskind, M D, Ph D, and Elmer L Sevringhaus, M D, GENERAL SURGERY Edited by Evarts A Graham, M D UROLOGY Edited by John H Cunningham, EYE, EAR, NOSE AND THROAT Edited by E V L Brown, M D, Louis Bothman, M D, George E Shambaugh, M D, Elmer W Hagens, M D, and George E Shambaugh, Jr, RADIOLOGY Edited by Charles A Waters, M D, Whitmer B Firor, M D, and Ira I Kaplan, M D, B Sc, Chicago The Year Book Publishers, Inc, 1937

THE PATIENT AND THE WEATHER SURGICAL PROBLEMS, Vol IV, Part 3 By William F Petersen, M D, and Margaret E Milliken, S M Ann Arbor, Mich Edwards Brothers, Inc, 1938

THORACIC SURGERY By Ferdinand Sauerbruch, M D, and Laurence O'Shaughnessy, M D, F R C S, Eng Baltimore William Wood & Co, 1937

THE PRACTICE OF UROLOGY By Leon Herman, M D Philadelphia and London W B Saunders Co, 1938

APPROVED LABORATORY TECHNIC By John A Kolmer, M D, Dr P H, Sc D, LL D, L H D, and Fred Boerner, V M D, 2nd ed, New York and London D Appleton-Century Co, 1938

FEVER THERAPY Edited by Members of the American Committee and directed by Walter M Simpson, M D, and William Bierman New York Paul B Hoeber, Inc, 1937

SPEECH TRAINING FOR CASES OF CLEFT PALATE By M C Oldfield, M Ch (Oxon), F R C S London H K Lewis & Co, Ltd, 1938

A HISTORY OF WOMEN IN MEDICINE By Kate Campbell Hurd-Mead, M D Haddam, Conn Haddam Press, 1938

MEN PAST FORTY By A F Niemoller, A B, M A, B S New York Harvest House, 1938

FRACTURES AND DISLOCATIONS Two volumes By Philip Levin, M D Edited by Morris Fishbein, M D, New York National Medical Book Co, Inc, 1937

EMERGENCY SURGERY By Hamilton Bailey, F R C S, (England) Third Edition, William Wood and Company, Baltimore, 1938

EDITORIAL ADDRESS

Original typed manuscripts and illustrations submitted to this Journal should be forwarded prepaid, at the author's risk, to the Chairman of the Editorial Board of the ANNALS OF SURGERY

Walter Estell Lee, M D

1833 Pine Street, Philadelphia, Pa

Contributions in a foreign language when accepted will be translated and published in English

Exchanges and Books for Review should be sent to James T Pilcher, M D, Managing Editor, 121 Gates Avenue, Brooklyn, N Y

Subscriptions, advertising and all business communications should be addressed

ANNALS OF SURGERY

227 South Sixth Street Philadelphia Pa

INDEX TO VOLUME 107

A

Abdomen, Acute, and Mesenteric Lymphadenitis, 359
Abdominal Approach in Repair of Inguinal Hernia, 917, Incision, Glass Rods and Other Items in Technic of, 996, Scar, Rupture of Intestine into, 472, Surgery, Complicating Effects of Diverticulitis of the Colon Upon, 801, Wall, Neoplasms of, 278
ABELL, IRVIN Introductory Address, 641
Abscess, Brain, Due to Gas-forming, Spore-bearing Anaerobes, 681, Sulfanilamide in Treatment of, 620, of Undetermined Etiology, 492
Abscess, Intraperitoneal Streptococcic, Complicating Acute Pharyngitis, 469, Lung, 753
Active and Prophylactic Use of Zinc Peroxide in Foul Smelling Mouth and Neck Infections, 32
Acute Abdomen and Mesenteric Lymphadenitis, 359, Ileus, 321, Inflammatory Jejunitis with Intestinal Obstruction, 147, Intestinal Obstruction, 340
ADAMS, WILLIAM E Mesenteric Lymphadenitis and the Acute Abdomen, 359
Address, Introductory, Toastmaster, 641, Presidential, 644
ADKINS, ELMER H Ptosed Spleen with Torsion of Pedicle, 832
Adrenal Cortical Tumors and Their Treatment, 881
Air in the Body Tissues, Oxygen for the Absorption of, 1
ALEXANDER, WILLIAM F Complete Sympathetic Denervation of the Upper Extremity, 25
ALLEN, ARTHUR W Carcinoma of the Stomach with Special Reference to Total Gastrectomy, 770, Obituary of Daniel Fiske Jones, by, 1037
ALTEMEIER, WILLIAM A Bacterial Flora of Acute Perforated Appendicitis with Peritonitis, 517, Cause of Putrid Odor of Perforated Appendicitis with Peritonitis, 634
Ambulatory Treatment of Fracture of Patella, 311
Anaerobes, Gas-forming, Spore-bearing, Brain Abscess Due to, 681
Anesthesia, Degeneration of Brain Following Nitrous Oxide-Oxygen, 486, Pathogenesis of Necrosis of the Cerebral Gray Matter Following Nitrous Oxide 371
Aneurysm, Intracranial, of the Internal Carotid Artery, 654
Aneurysms of the Circle of Willis, 660, Traumatic Arteriovenous, Early Cardiac Decompensation in, 1029
Appendices Epiploicae, Obstruction Due to, 153
Appendicitis, Acute, in Complete Transposition of Viscera, 511, Resulting from External Trauma, Rare Incidence of, 529
Appendicitis, in Army Service, 242 Perforated, with Peritonitis, Bacterial Flora of Acute, 517, Perforated, with Peritonitis, Cause of Putrid Odor of, 634
Appendix, Retroperitoneal (Retrocolic), 819
Approach, Abdominal, in Repair of Inguinal Hernia, 917
Argentaffine Tumors of Gastro-intestinal Tract, 260
ARIES, LEON J Spontaneous Choledochogastrostomy and Cholecystogastrostomy, 229
Army Service, Appendicitis in, 242
Arteriovenous Aneurysms, Traumatic, Early Cardiac Decompensation in, 1029
Artery, Internal Carotid, Intracranial Aneurysm of, 654, of Single Transplanted Kidney, Hypertension Experimentally Produced by Constricting, 618
Ascending Colon and Cecum, Volvulus of the, 248

B

Back Pain, Lumbosacral and Sacro-iliac Strain Causing Low, 988
BACON, HARRY E Endometriosis of Rectum and Sigmoid, 1022
Bacterial Flora, of Acute Perforated Appendicitis with Peritonitis, 517, of Clean Surgical Wounds, 607
BAGLEY, CHARLES, Jr Brain Abscess Due to Gas-forming Spore-bearing Anaerobes, 681
Balance, Water, in Neurosurgical Patients, 438
BALFOUR DONALD Obituary of Ingersoll Olmsted, 314
BARKER, M HERBERT Surgical Problem of Hypertension, 899
BARNEY, J DRILLINGER A Point in Clinical Diagnosis of Ureteral Calculus, 636
BAUMFISTER, CARL Obstruction Due to Appendices Epiploicae, 153
BEALL, FRANK C Stones in the Common Bile Duct, 238
Bile Duct, Common, Stones in the 238

Bile Ducts, Spontaneous Postoperative Rupture of the, 558
Bishop, George H Mechanism of Spastic Vascular Disease and Its Treatment, 270
Black, William T Posterior Vaginal Hernia, 855
Bliss, Raymond W Appendicitis in Army Service, 242
Block, Frank B Acute Appendicitis in Complete Transposition of Viscera, 511
Blood Loss in Neurosurgical Operations, 287
Body Tissues, Oxygen for the Absorption of Air from the, 1
Bond, Douglas D Treatment of Hemorrhage and Traumatic Shock by Intravenous Use of Lyophile Serum, 500
Bone Drilling, Rationale, in Delayed and Ununited Fractures, 303
Bone, Right Iliac, Gunshot Wound of, 155
Book Review Management of Fractures, Dislocations and Sprains, by John Albert Key, Reviewed by Robert L Preston, 319, Postgraduate Surgery, by Rodney Maingot Reviewed by Charles G Heyd, 316
Books Received, 320, 1040
Bradford, F Keith Intramedullary Dermoid Cyst, 107, Scalenus Neurocirculatory Compression, 708
Brain Abscess, Due to Gas-forming, Spore-bearing Anaerobes, 681, Sulfanilamide in Treatment of, 620, of Undetermined Etiology, 492, Brain, Degeneration of, Following Nitrous Oxide-Oxygen Anesthesia, 486
Branch, Charles D Injury of the Liver, 475
Breast, Carcinoma of the, 733, Factors Influencing Prognosis of, 207, in the Negro, 716
Brenizer, Addison G Use of Fascia and Ribbon Catgut in Repair of Cleft Palate and Harelip, 692
Brown, James B Repair of Surface Defects of Hand, 952
Brownson, Kneale M Dermoid Cysts of the Mesentery, 566
Bullock, Wallfr O Glass Rods and Other Items in Technic of Abdominal Incision, 996
Bush, Jasper D Early Cardiac Decompensation in Traumatic Arteriovenous Aneurysms, 1029
Butsch, Winfield L Surgical Consideration of Solitary Polyps of the Colon, 540

C

Calculus, Ureteral, Clinical Diagnosis of, 636
Carcinoma of the Breast, 733, Factors Influencing Prognosis in, 207, in the Negro, 716
Carcinoma of the Stomach, 770
Cardiac Decompensation, Early, in Traumatic Arteriovenous Aneurysms, 1029
Carothers, Ralph G Internal Fixation of Fractures of Neck of Femur, 980
Carotid Artery, Internal, Intracranial Aneurysm of, 654
Cave, Henry W Surgical Treatment of Intractable Chronic Ulcerative Colitis, 806
Cecum and Ascending Colon, Volvulus of the, 248
Celiac Ganglionectomy, Clinical Results of, in Treatment of Essential Hypertension, 909
Cerebral Gray Matter, Pathogenesis of Necrosis of the, Following Nitrous Oxide Anesthesia, 371
Cervical Spine, Giant Cell Tumor of the, 298
Chemistry of the Brain, Edited by Charles C Thomas Co, Review of, 640
Child, Charles G Hypertension Experimentally Produced by Constricting Artery of a Single Transplanted Kidney, 618
Children, Injuries about Shoulder Joint in, Exclusive of Fractures of Clavicle, 594, Simple Treatment for Empyema in, 739
Cholecystitis, Results of Conservative Treatment of Acute, 543
Cholecystogastrostomy and Choledochogastrostomy, Spontaneous, 229
Choledochogastrostomy and Cholecystogastrostomy, Spontaneous, 229
Chronic Ileocolitis, Colectomy for, 148, Inflammatory Tumor of the Mesentery, 151, Ulcerative Colitis, Surgical Treatment of Intractable, 806
Circle of Willis, Aneurysms of the, 660
Clean Surgical Wounds, Bacterial Flora of, 607
Cleft Palate and Harelip, Use of Fascia and Ribbon Catgut in Repair of, 692
Clinical Diagnosis of Ureteral Calculus, 636, Results of Celiac Ganglionectomy in Treatment of Essential Hypertension, 909
Cohn, Isidore Carcinoma of the Breast in the Negro, 716
Colectomy for Chronic Ileocolitis, 148
Coleman, F P Postanesthetic Encephalopathy Following Cyclopropane, 481
Colitis, Chronic Ulcerative, Surgical Treatment of Intractable, 806
Colon, Ascending, and Cecum, Volvulus of the, 248, Diverticulitis of the, Complicating Effects Upon Abdominal Surgery, 801, Solitary Polyps of the, Surgical Consideration of, 540
Colp, Ralph Nonspecific Granulomata of the Intestine, 74
Common Bile Duct, Stones in the, 238
Communicating Veins of Lower Leg and Operative Technic for Their Ligation, 582
Comparative Tourniquet Test, Modern Treatment of Varicose Veins as Indicated by, 927
Comparison of Three Types of Hysterectomy, 836

Complicating Effects of Diverticulitis of the Colon Upon Abdominal Surgery, 801
Complications, Postoperative, Influence of Preoperative Medication on, 972
Compression, Scalenus Neurocirculatory, 708
Conservative Treatment of Acute Cholecystitis, Results of, 543
Constricting Artery of Single Transplanted Kidney Hypertension Experimentally Produced by, 618
Constructing a Vagina, Simple Method of, 842
Contracture, Dupuytren's, 122
CONWAY, FRANCIS M Spontaneous Rupture of Uterus Due to Hydatidiform Mole, 627
Cortical Tumors, Adrenal, and Their Treatment, 881
COURVILLE, CYRIL B Pathogenesis of Necrosis of the Cerebral Gray Matter Following Nitrous Oxide Anesthesia, 371
CRILE, GEORGE Clinical Results of Celiac Ganglionectomy in Treatment of Essential Hypertension, 909
Cyclopropane, Postanesthetic Encephalopathy Following, 481
Cyst, Intramedullary Dermoid, 107, Unilocular, of Liver, 829
Cysts, Dermoid, of the Mesentery, 566, Vaginal, 863

D

DANDY, WALTER E Intracranial Aneurysm of the Internal Carotid Artery, 654
DAVID, VERNON C Complicating Effects of Diverticulitis of the Colon Upon Abdominal Surgery, 801
DAVIS, HERBERT H Factors Influencing Prognosis in Carcinoma of the Breast, 207
DAVIS, LOYAL Surgical Problem of Hypertension, 899
DAVISON, MARSHALL Spontaneous Choledochogastrostomy and Cholecystogastrostomy, 229
Decompensation, Early Cardiac, in Traumatic Arteriovenous Aneurysms, 1029
Defects of Hand, Repair of Surface, 952
Degeneration of Brain Following Nitrous Oxide-Oxygen Anesthesia, 486
Delayed and Ununited Fractures, Rationale of Bone Drilling in, 303
Denervation of the Upper Extremity, Complete Symphathetic, 25
Dermoid Cyst, Intramedullary, 107, of the Mesentery, 566
Diagnosis, Clinical, of Ureteral Calculus, 636
Diaphragmatic Hernia, Method of Reducing, from Above, 143
Direct Inguinal Hernia, 572
Disease, Spastic Vascular, and Its Treatment Mechanism of, 270
Diverticula of the Jejunum, 783
Diverticulitis of the Colon, Complicating Effects of Upon Abdominal Surgery, 801
Diverticulum of Female Urethra, 923
Duct, Common Bile Stones in the, 238
DUDLEY, GUILFORD S Inflammatory Tumors of the Gastro-intestinal Tract, 55
Duodenal and Gastric Ulcer, Perforated, 350
Dupuytren's Contracture, 122
DWIGHT, RICHARD W Pilonidal Sinus, 400

E

Early Cardiac Decompensation in Traumatic Arteriovenous Aneurysms, 1029
EASTON, E R Rationale of Bone Drilling in Delayed and Ununited Fractures, 303
EBERHARD, THEODORE P Generalized Lymphogranuloma Inguinale 380
EGGERS, CARL Plastic Reconstruction of the Esophagus, 50
Empyema in Children, Simple Treatment for, 739
Encephalopathy, Postanesthetic, Following Cyclopropane, 481
Endometriosis of Rectum and Sigmoid, 1022
Epiploicae, Appendices, Obstruction due to, 153
Esophageal-tracheo Fistula, 701
Esophagus, Plastic Reconstruction of the, 50
Essential Hypertension, Clinical Results of Celiac Ganglionectomy in Treatment of, 909
Etiology, Brain Abscess of Undetermined, 492
External Trauma, Rare Incidence of Acute Appendicitis Resulting from, 529
Extremity, Upper, Complete Sympathetic Denervation of the, 25

F

Factors Influencing Prognosis in Carcinoma of the Breast, 207
FALLIS, LAWRENCE S Direct Inguinal Hernia, 572
Fascia and Ribbon Catgut, Use of, in Repair of Cleft Palate and Harelip, 692
Female Urethra, Diverticulum of, 923
Femur, Internal Fixation for Recent Fractures of Neck of, 132, Neck of, Internal Fixation of Fractures of, 980, Treatment of Fractures of the Shaft of the, 419
FINE, JACOB Further Clinical Experiences with 95 Per Cent Oxygen for the Absorption of Air from the Body Tissues, 1
Fistula, Tracheo-esophageal, 701
Fixation, Internal, of Fractures of Neck of Femur, 980, for Recent Fractures of Neck of Femur, 132
Flora, Bacterial, of Acute Perforated Appendicitis with Peritonitis, 517, of Clean Surgical Wounds, 607

Foul Smelling Mouth and Neck Infections, Prophylactic and Active Use of Zinc Peroxide in, 32
Fowler, Royal H Rare Incidence of Acute Appendicitis Resulting from External Trauma, 529
Fracture of Patella, Ambulatory Treatment of 311
Fractures, Delayed and Ununited, Rationale of Bone Drilling in, 303, of Neck of Femur, Internal Fixation for Recent, 132, 980, of the Shaft of the Femur, Treatment of, 419
Frank, L Wallace Thoracoplasty in Treatment of Pulmonary Tuberculosis, 745
Frehling, Stanley Further Clinical Experiences with 95 Per Cent Oxygen for the Absorption of Air from the Body Tissues, 1
Furcolo, Charles L Complete Sympathetic Denervation of the Upper Extremity, 25

G

Gamble, Hugh A Tracheo-esophageal Fistula 701
Ganglionectomy, Celiac, Clinical Results of, in Treatment of Essential Hypertension, 909
Garlock, John H The So-called Hepatorenal Syndrome, 82
Gas-forming, Spore-bearing Anaerobes, Brain Abscess Due to 681
Gastric and Duodenal Ulcer, Perforated, 350
Gastro-intestinal Tract, Argentaffine Tumors of, 260, Inflammatory Tumors of the, 55
Gastrostomy, Spivack's, 1005
Gebauer P W Postanesthetic Encephalopathy Following Cyclopropane, 481
Gerster, John C A Diverticula of the Jejunum, 783
Giant Cell Tumor of the Cervical Spine, 298
Gilchrist, R Kennedy Complicating Effects of Diverticulitis of the Colon Upon Abdominal Surgery, 801
Gilcreest Edgar L Lumbosacral and Sacro-iliac Strain Causing Low Back Pain 988
Gill A Bruce Dupuytren's Contracture, 122
Glass Rods and Other Items in Technic of Abdominal Incision, 996
Glenn, Frank Hypertension Experimentally Produced by Constricting Artery of a Single Transplanted Kidney, 618
Glomangioma, 128
Glomus Tumor, 128
Glossitis Rhombica Mediana, 39
Graham George S Early Cardiac Decompensation in Traumatic Arteriovenous Aneurysms, 1029
Grant, Francis C Brain Abscess of Undetermined Etiology, 492, Results in the Operative Treatment of Major Trigeminal Neuralgia, 14
Granulomata, Nonspecific, of the Intestine, 74
Gray Matter, Pathogenesis of Necrosis of the Cerebral, Following Nitrous Oxide Anesthesia, 371
Groff, Robert A Brain Abscess of Undetermined Etiology, 492
Gunshot Wound of Right Iliac Bone, 155

H

Hagard William D Obituary of Duncan Eve, 478
Haight, Cameron Intratracheal Suction in Management of Postoperative Pulmonary Complications, 218
Hand, Repair of Surface Defects of, 952
Harelip and Cleft Palate, Use of Fascia and Ribbon Catgut in Repair of, 692
Hargens, C W Obstruction Due to Appendices Epiploicae, 153
Heart, Stab Wound of, 21 Years After Suture, 311
Heaton, Leonard D Appendicitis in Army Service, 242
Heinbecker, Peter Mechanism of Spastic Vascular Disease and Its Treatment, 270
Hemorrhage and Traumatic Shock, Treatment of, by Intravenous Use of Lyophile Serum, 500
Henderson, Melvin S Internal Fixation for Recent Fractures of Neck of Femur, 132
Hepatorenal Syndrome the So-called, 82
Herrmanson, Louis Further Clinical Experiences with 95 Per Cent Oxygen for the Absorption of Air from the Body Tissues, 1
Hernia, Abdominal Approach in Repair of Inguinal, 917 Direct Inguinal, 572, Method of Reducing Large Diaphragmatic from Above, 143, Posterior Vaginal, 855
Heuer, George J Hypertension Experimentally Produced by Constricting Artery of a Single Transplanted Kidney, 618
Heyd, Charles Gordon Review of Postgraduate Surgery, Edited by Rodney Maingot, Reviewed by, 316
Hirshfeld, John W Bacterial Flora of Clean Surgical Wounds, 607
Holden, Gerry R Obituary of James Knox Simpson by, 874
Howe, Elizabeth Glossitis Rhombica Mediana, 39
Huches, Joseph Chemistry of the Brain, Edited by Charles C Thomas Co, Reviewed by, 640
Hurwitt, E S Blood Loss in Neurosurgical Operations, 287, Water Balance in Neurosurgical Patients, 438

Hydatidiform Mole, Spontaneous Rupture of Uterus Due to, 627
Hypertension, Essential, Clinical Results of Celiac Ganglionectomy in Treatment of, 909, Experimentally Produced by Constricting the Artery of a Single Transplanted Kidney, 618, Surgical Problem of, 899
Hyperthyroidism, Short-interval Stage Operations for Severe, 198
Hysterectomy, Comparison of Three Types of, 836

I

Ileocolitis, Colectomy for Chronic, 148
Ileus, Acute, 321
Iliac Bone, Right, Gunshot Wound of, 155
Incidence, Rare, of Acute Appendicitis Resulting from External Trauma, 529
Incision, Abdominal, Glass Rods and Other Items in Technic of, 996
Infections, Foul Smelling, of Mouth and Neck, Prophylactic and Active Use of Zinc Peroxide in, 32
Inflammatory Jejunitis, Acute, with Intestinal Obstruction, 147, Tumor, Chronic, of the Mesentery, 151, Tumors of the Gastro-intestinal Tract, 55
Influence of Preoperative Medication on Postoperative Complications, 972
Inguinal Hernia, Abdominal Approach in Repair of, 917, Direct, 572
Inguinale, Lymphogranuloma, 380
Injuries about Shoulder Joint in Children Exclusive of Fractures of Clavicle, 594
Injury of the Liver, 475
Internal Carotid Artery, Intracranial Aneurysm of, 654
Internal Fixation, of Fractures of Neck of Femur, 980, for Recent Fractures of Neck of Femur, 132
Intestinal Obstruction, Acute, 161, 340, Acute Inflammatory Jejunitis with, 147
Intestine, Nonspecific Granulomata of the, 74, Rupture of, into Abdominal Scar, 472
Intracranial Aneurysm of the Internal Carotid Artery, 654
Intractable Chronic Ulcerative Colitis, Surgical Treatment of, 806
Intramedullary Dermoid Cyst, 107
Intraperitoneal Streptococcic Abscess Complicating Acute Pharyngitis, 469
Intratracheal Suction in Management of Postoperative Pulmonary Complications, 218
Intravenous Use of Lyophile Serum, Treatment of Hemorrhage and Traumatic Shock by, 500
Introductory Address, Toastmaster, 641
IVIS, HOWARD R Bacterial Flora of Clean Surgical Wounds, 607

J

Jejunitis, Acute Inflammatory, with Intestinal Obstruction, 147
Jejunum, Diverticula of the, 783
JONES, JOHN F X Stab Wound of Heart 21 Years After Suture, 311

K

KENNEDY, ROBERT H Treatment of Fractures of the Shaft of the Femur, 419
KEPLER, EDWIN J Adrenal Cortical Tumors and Their Treatment, 881
KEYES, HAROLD BROWN Stenosing Tendovaginitis at the Radial Styloid Process, 602
Kidney, Hypertension Experimentally Produced by Constricting Artery of a Single Transplanted, 618
KLEIN, SAMUEL H The So-called Hepatorenal Syndrome, 82
KLINGENSTEIN, PERCY Acute Inflammatory Jejunitis with Intestinal Obstruction, 147, Chronic Inflammatory Tumor of the Mesentery, 151, Colectomy for Chronic Ileocolitis, 148
Knots, Surgical, 458
KOLODNY, ANATOLE Glomus Tumor, 128
KUNTZ, ALBERT Complete Sympathetic Denervation of the Upper Extremity, 25

L

Large Bowel, Surgery of the, Complicating Effects of Diverticulitis of the Colon Upon Abdominal Surgery and Especially Upon, 801
LAZARUS, JOSEPH A Neoplasms of Abdominal Wall, 278
Leg, Lower, [illegible] ns of, and Operative Ligation, 582
Ligation of Communicating Veins of Lower Leg, Technic for, 582
LINTON, ROBERT R Communicating Veins of Lower Leg and Operative Technic for Their Ligation, 582
Liver, Injury of the, 475, Spontaneous Rupture of the, in Malaria, 473, Unilocular Cyst of, 829
Loss, Blood, in Neurosurgical Operations, 287
Lower Leg, Communicating Veins of, and Operative Technic for Their Ligation, 582
LOWER, WILLIAM E Diverticulum of Female Urethra, 923
Lumbosacral and Sacro-iliac Strain Causing Low Back Pain, 988
Lung Abscess, 753
Lymphadenitis Mesenteric, and the Acute Abdomen, 359
[illegible] Inguinale, 380
[illegible] Treatment of Hemorrhage and Traumatic Shock by Intravenous Use of, 500

M

MAGE, SIGMUND Gunshot Wound of Right Iliac Bone 155 Rupture of Intestine into Abdominal Scar, 472

MAHORNER, HOWARD R Modern Treatment of Varicose Veins as Indicated by Comparative Tourniquet Test, 927
MAJOR, ROBERT C Lung Abscess, 753
Major Trigeminal Neuralgia, Operative Treatment of, 14
Malaria, Spontaneous Rupture of the Liver in, 473
MARBURY, WILLIAM B Retroperitoneal (Retrocolic) Appendix, 819
MARTIN, HAYES E Glossitis Rhombica Mediana, 39
MASON, JAMES M Early Cardiac Decompensation in Traumatic Arteriovenous Aneurysms, 1029
MASSON, CLEMENT B Spasmodic Torticollis Treated by the Plastic Reduction of Motor Fibers of the Spinal Accessory Nerve, 20
MASTIN, E VERNON Influence of Preoperative Medication on Postoperative Complications, 972
MATAS, RUDOLPH Aneurysms of the Circle of Willis, 660
MAYO, CHARLES W Surgical Consideration of Solitary Polyps of the Colon, 540
McCREERY, JOHN A Perforated Gastric and Duodenal Ulcer, 350
McEWAN, DUNCAN Spontaneous Rupture of the Liver in Malaria, 473
McEWAN, JOHN S Spontaneous Rupture of the Liver in Malaria, 473
McGRAW, ARTHUR B Short-interval Stage Operations for Severe Hyperthyroidism, 198
McKIRDIE, MATTHEW Pilonidal Sinus, 389
Mechanism of Spastic Vascular Disease and Its Treatment, 270
Mediana, Glossitis Rhombica, 39
Medication, Influence of Preoperative, on Postoperative Complications, 972
MELENEY, FRANK L Prophylactic and Active Use of Zinc Peroxide in Foul Smelling Mouth and Neck Infections, 32
Mesenteric Lymphadenitis and the Acute Abdomen, 359
Mesentery, Chronic Inflammatory Tumor of the, 151, Dermoid Cysts of the, 566
Method for Reducing Large Diaphragmatic Hernia from Above, 143, Simple, of Constructing a Vagina, 842
MICHAEL, MAURICE A Acute Appendicitis in Complete Transposition of Viscera, 511
MISCALL, LAURENCE Inflammatory Tumors of the Gastro-intestinal Tract, 55
Modern Treatment of Varicose Veins as Indicated by Comparative Tourniquet Test, 927
Mole, Hydatidiform, Spontaneous Rupture of Uterus Due to, 627
MORSMAN, C F Obstruction Due to Appendices Epiploicae, 153
Motor Fibers of Spinal Accessory Nerve, Spasmodic Torticollis Treated by Reduction of, 20
Mouth and Neck Infections, Foul Smelling, Prophylactic and Active Use of Zinc Peroxide in, 32

N

Neck of Femur, Fractures, Internal Fixation for Recent, 132, Internal Fixation of Fractures of, 980
Neck and Mouth Infections, Foul Smelling, Prophylactic and Active Use of Zinc Peroxide in, 32
Necrosis, Pathogenesis of, of the Cerebral Gray Matter Following Nitrous Oxide Anesthesia, 371
Negro, Carcinoma of the Breast in the, 716
Neoplasms of Abdominal Wall, 278
Neuralgia, Major Trigeminal, Operative Treatment of, 14
Neurocirculatory Compression, Scalenus, 708
Neurosurgical Operations, Blood Loss in, 287, Patients, Water Balance in, 438
NEWBURGER, BERNHARD Spontaneous Postoperative Rupture of the Bile Ducts, 558
NICHOLSON, JESSE T Giant Cell Tumor of the Cervical Spine, 298
Nitrous Oxide Anesthesia Pathogenesis of Necrosis of the Cerebral Gray Matter Following, 371
Nitrous Oxide-Oxygen Anesthesia, Degeneration of Brain Following, 486
Nonspecific Granulomata of the Intestine, 74

O

Obituary Eve, Duncan, 478, Goodwin, William Hall, 872, Jones, Daniel Fiske, 1037, Olmsted, Ingersoll, 314, Scrimger, Francis Alexander Carron, 159, Simpson, James Knox, 874, Stokes, James Ernest, 876, Winslow, Nathan, 879
O'BRIEN, JOHN D Severe Degeneration of Brain Following Nitrous Oxide-oxygen Anesthesia, 486
Obstruction, Acute Intestinal, 161, 340, Intestinal, Acute Inflammatory Jejunitis with, 147, Due to Appendices Epiploicae, 153
OCHSNER, ALTON Modern Treatment of Varicose Veins as Indicated by Comparative Tourniquet Test, 927
OCHSNER, EDWARD H Unilocular Cyst of Liver, 829
Odor, Putrid, of Perforated Appendicitis with Peritonitis, 634
OLNEY, MARY B Mesenteric Lymphadenitis and the Acute Abdomen, 359
Operations, Neurosurgical, Blood Loss in, 287, Short-interval Stage, for Severe Hyperthyroidism, 198
Operative Technic for Ligation of Communicating Veins of Lower Leg, 582, Treatment of Major Trigeminal Neuralgia, 14

INDEX TO VOLUME 107

OUTLAND, TOM A Tears of the Supraspinatus Tendon, 116
Oxygen for Absorption of Air from Body Tissues, 1

P

Pain, Low Back, Lumbosacral and Sacroiliac Strain Causing, 988
Patella, Fracture of, Ambulatory Treatment of, 311
Pathogenesis of Necrosis of the Cerebral Gray Matter Following Nitrous Oxide Anesthesia, 371
Patients, Water Balance in Neurosurgical, 438
Pedicle, Ptosed Spleen with Torsion of, 832
PEMBERTON, JOHN DEJ Tumors Ventral to the Sacrum, 96
PENBERTHY, GROVER C Dermoid Cysts of the Mesentery, 566
PENNOYER, GRANT P Results of Conservative Treatment of Acute Cholecystitis, 543
Perforated Appendicitis with Peritonitis, Cause of Putrid Odor of, 634, Bacterial Flora of Acute, 517
Perforated Gastric and Duodenal Ulcer, 350
Peritonitis, Bacterial Flora of Acute Perforated Appendicitis with, 517, and Perforated Appendicitis, Cause of Putrid Odor of, 634
Pharyngitis, Acute, Intraperitoneal Streptococcic Abscess Complicating, 469
Pilonidal Sinus, 389, 400
Plastic Reconstruction of the Esophagus, 50, Reduction of Motor Fibers of Spinal Accessory Nerve, Spasmodic Torticollis Treated by, 20
Polyps of the Colon, Surgical Consideration of Solitary, 540
Postanesthetic Encephalopathy Following Cyclopropane, 481
Posterior Vaginal Hernia, 855
Postoperative Complications, Influence of Preoperative Medication on, 972, Pulmonary Complications, Intratracheal Suction in Management of, 218, Spontaneous, Rupture of the Bile Ducts, 558
Preoperative Medication, Influence of, on Postoperative Complications, 972
Presidential Address, 644
PRESTON, ROBERT L Review of Management of Fractures, Dislocations and Sprains, Edited by John Albert Key, Reviewed by, 319
PREWITT, PROVISO V Rationale of Bone Drilling in Delayed and Ununited Fractures, 303
Problem, Surgical, of Hypertension, 899
Process, Radial Styloid, Stenosing Tendovaginitis at the, 602
Prognosis in Carcinoma of the Breast, Factors Influencing, 207
Prophylactic and Active Use of Zinc Peroxide in Foul Smelling Mouth and Neck Infections, 32
Ptosed Spleen with Torsion of Pedicle, 832
Pulmonary Complications, Postoperative, Intratracheal Suction in Management of, 218, Tuberculosis, Thoracoplasty in Treatment of, 745
Putrid Odor of Perforated Appendicitis with Peritonitis, 634

R

Radial Styloid Process, Stenosing Tendovaginitis at the, 602
RANKIN, FRED W Presidential Address, 644
Rare Incidence of Acute Appendicitis Resulting from External Trauma, 529
Rationale of Bone Drilling in Delayed and Ununited Fractures, 303
Reconstruction, Plastic, of the Esophagus, 50
Rectum and Sigmoid, Endometriosis of, 1022
Reducing Large Diaphragmatic Hernia from Above, Method of, 143
Repair of Inguinal Hernia, Abdominal Approach in, 917, of Surface Defects of Hand, 952
Results, Clinical, of Celiac Ganglionectomy in Treatment of Essential Hypertension, 909, of Conservative Treatment of Acute Cholecystitis, 543
Retrocolic (Retroperitoneal) Appendix, 819
Retroperitoneal (Retrocolic) Appendix, 819
Rhombica Mediana, Glossitis, 39
Ribbon Catgut and Fascia, Use of, in Repair of Cleft Palate and Harelip, 692
Right Iliac Bone, Gunshot Wound of, 155
RIVES, JAMES D Lung Abscess, 753
Rods, Glass, and Other Items in Technic of Abdominal Incision, 996
ROGERS, HORATIO Pilonidal Sinus, 400
ROMANO, SAMUEL A Lung Abscess, 753
ROWE, STUART N Use of Sulfanilamide in Treatment of Brain Abscess, 620
ROYSTER, HUBERT A Obituary of James Ernest Stokes, by, 876
Rupture, of the Bile Ducts, Spontaneous Postoperative, 558, of Intestine into Abdominal Scar, 472, Spontaneous, of the Liver in Malaria, 473, Spontaneous, of Uterus Due to Hydatidiform Mole, 627

S

Sacro-Iliac and Lumbosacral Strain Causing Low Back Pain, 988
Sacrum, Tumors Ventral to the, 96
ST JACQUES, EUGENE Ambulatory Treatment of Fracture of Patella 311
SANDERS, ROBERT L Vaginal Cyst, 863
Scalenus Neurocirculatory Compression, 708

Scar, Abdominal, Rupture of Intestine into, 472
SCHOFIELD, JAMES D Endometriosis of Rectum and Sigmoid, 1022
SCUDDER, JOHN Acute Intestinal Obstruction, 161
Service, Army, Appendicitis in, 242
Shaft of the Femur, Treatment of Fractures of the, 419
SHEPHERD, WALTER F Tears of the Supraspinatus Tendon, 116
SHIPLEY, ARTHUR M Obituary of Nathan Winslow, by, 879
Short-interval Stage Operations for Severe Hyperthyroidism, 198
Shoulder Joint in Children, Injuries About, Exclusive of Fractures of Clavicle, 594
Sigmoid and Rectum, Endometriosis of, 1022
Simple Method of Constructing a Vagina, 842, Treatment for Empyema in Children, 739
Sinus, Pilonidal, 389, 400
SLOAN, HARRY G Method of Reducing Large Diaphragmatic Hernia from Above, 143
SMITH, BEVERLY C Acute Ileus, 321
Solitary Polyps of the Colon, Surgical Consideration of, 540
Spasmodic Torticollis Treated by Plastic Reduction of Motor Fibers of Spinal Accessory Nerve, 20
Spastic Vascular Disease and Its Treatment, Mechanism of, 270
Spinal Accessory Nerve, Spasmodic Torticollis Treated by Plastic Reduction of Motor Fibers of the, 20
Spine, Cervical, Giant Cell Tumor of the, 298
Spivack's Gastrostomy, 1005
Spleen, Ptosed, with Torsion of Pedicle, 832
Spontaneous Choledochogastrostomy and Cholecystogastrostomy, 229, Postoperative Rupture of the Bile Ducts, 558, Rupture of the Liver in Malaria, 473 Rupture of Uterus Due to Hydatidiform Mole, 627
Spore-bearing, Gas-forming Anaerobes, Brain Abscess Due to, 681
SPURLING, R GLEN Scalenus Neurocirculatory Compression, 708
Stab Wound of Heart 21 Years After Suture, 311
Stage Operation, Short-interval, for Severe Hyperthyroidism, 198
STEEGMANN, ALBERT T Severe Degeneration of Brain Following Nitrous Oxide-oxygen Anesthesia, 486
STENGEL, ALFRED, JR Uveoparotitis, 1000
Stenosing Tendovaginitis at Radial Styloid Process, 602
Stomach, Carcinoma of the, 770
Stones in the Common Bile Duct, 238
Strain Lumbosacral and Sacro-iliac, Causing Low Back Pain, 988
Streptococcic Abscess, Intraperitoneal, Complicating Acute Pharyngitis, 469
Styloid Process, Radial, Stenosing Tendovaginitis at the, 602
Suction, Intratracheal, in Management of Postoperative Pulmonary Complications, 218
Sulfanilamide in Treatment of Brain Abscess, 620
SULLIVAN, JOHN E Injuries about Shoulder Joint in Children Exclusive of Fractures of Clavicle, 594
Supraspinatus Tendon, Tears of the 116
Surface Defects of Hand, Repair of, 952
Surgery of the Large Bowel, Complicating Effects of Diverticulitis of the Colon Upon Abdominal Surgery and Especially Upon 801
Surgical Consideration of Solitary Polyps of the Colon, 540, Knots, 458, Problem of Hypertension, 899, Treatment of Intractable Chronic Ulcerative Colitis, 806, Wounds, Clean, Bacterial Flora of, 607
Suture, Stab Wound of Heart, 21 Years After, 311
SWEET, W H Blood Loss in Neurosurgical Operations 287, Water Balance in Neurosurgical Patients, 438
Sympathetic Denervation of the Upper Extremity Complete, 25
Syndrome, The So-called Hepatorenal, 82

T

TAYLOR, FREDERICK W Surgical Knots, 458
Tears of the Supraspinatus Tendon, 116
Tendon, Tears of the Supraspinatus, 116
Tendovaginitis, Stenosing, at Radial Styloid Process, 602
Thoracoplasty in Treatment of Pulmonary Tuberculosis, 745
Three Types of Hysterectomy, Comparison of, 836
Tissues, Oxygen for the Absorption of Air from the Body, 1
TODYO, T Acute Intestinal Obstruction, 340
TORMEY, THOMAS W Diverticulum of Female Urethra, 923
Torsion of Pedicle, Ptosed Spleen with, 832
Torticollis, Spasmodic, Treated by Plastic Reduction of Motor Fibers of Spinal Accessory Nerve, 20
Tourniquet Test, Comparative, Modern Treatment of Varicose Veins as Indicated by, 927
TOUROFF, ARTHUR S W Intraperitoneal Streptococcic Abscess Complicating Acute Pharyngitis, 469
Tracheo-Esophageal Fistula, 701

Tract, Gastro-intestinal, Argentaffine Tumors of, 260, Inflammatory Tumors of the Gastro-intestinal, 55
Transplanted Kidney, Hypertension Experimentally Produced by Constricting Artery of a Single, 618
Transposition of Viscera, Acute Appendicitis in Complete, 511
Trauma, External, Rare Incidence of Acute Appendicitis Resulting from, 529
Traumatic Arteriovenous Aneurysms, Early Cardiac Decompensation in, 1029, Shock and Hemorrhage, Treatment of, by Intravenous Use of Lyophile Serum, 500
Treatment, Ambulatory, of Fracture of Patella, 311, of Brain Abscess, Sulfanilamide in, 620, of Fractures of the Shaft of the Femur, 419, of Hemorrhage and Traumatic Shock by Intravenous Use of Lyophile Serum, 500, Modern, of Varicose Veins as Indicated by Comparative Tourniquet Test, 927, of Pulmonary Tuberculosis, Thoracoplasty in, 745 Results of Conservative, of Acute Cholecystitis, 543, Simple, for Empyema in Children, 739, Surgical, of Intractable Chronic Ulcerative Colitis, 806
Trigeminal Neuralgia, Major, Operative Treatment of, 14
TROUT, HUGH H Carcinoma of the Breast, 733
Tuberculosis, Pulmonary, Thoracoplasty in Treatment of, 745
Tumor, Giant Cell, of the Cervical Spine, 298, Glomus, 128, of the Mesentery, Chronic Inflammatory, 151
Tumors, Adrenal Cortical, and Their Treatment, 881, Argentaffine, of Gastro-intestinal Tract, 260, Inflammatory, of the Gastro-intestinal Tract, 55, Ventral to the Sacrum, 96
TURNER, PAUL Thoracoplasty in Treatment of Pulmonary Tuberculosis, 745
Types of Hysterectomy, Comparison of Three, 836
TYRONE, CURTIS H Comparison of Three Types of Hysterectomy, 836

U

Ulcer, Perforated Gastric and Duodenal, 350
Ulcerative Colitis, Chronic, Surgical Treatment of Intractable, 806
Unilocular Cyst of Liver, 829
Ununited and Delayed Fractures, Rationale of Bone Drilling in, 303
Upper Extremity, Complete Sympathetic Denervation of the, 25
Ureteral Calculus, Clinical Diagnosis of, 636
Urethra, Diverticulum of Female, 923
Use of Fascia and Ribbon Catgut in Repair of Cleft Palate and Harelip, 692
Uterus, Spontaneous Rupture of, Due to Hydatidiform Mole, 627
Uveoparotitis, 1000

V

Vagina, Simple Method of Constructing a, 842
Vaginal Cysts, 863, Hernia, Posterior, 855
VANBEUREN, FREDERICK T, JR Acute Ileus, 321
Varicose Veins, Modern Treatment of, as Indicated by Comparative Tourniquet Test, 927
Vascular Disease, Spastic, and Its Treatment, Mechanism of, 270
Veins, Communicating, of Lower Leg and Operative Technic for Their Ligation, 582, Varicose, Modern Treatment of, as Indicated by Comparative Tourniquet Test, 927
Viscera, Complete Transposition, Acute Appendicitis in, 511
Volvulus of the Cecum and Ascending Colon, 248

W

WAGNER, DAVID H Spivack's Gastrostomy, 1005
Wall, Abdominal, Neoplasms of, 278
WALTERS, WALTMAN Adrenal Cortical Tumors and Their Treatment, 881
Water Balance in Neurosurgical Patients, 438
WATTS, STEPHEN H Obituary of William Hall Goodwin, by, 872
WEINSTEIN, MANDEL Volvulus of the Cecum and Ascending Colon, 248
WHARTON, LAWRENCE R Simple Method of Constructing a Vagina, 842
WHIPPLE, ALLEN O Acute Intestinal Obstruction, 161
WHITE, J C Blood Loss in Neurosurgical Operations, 287, Water Balance in Neurosurgical Patients, 438
WHITELAW, G P Blood Loss in Neurosurgical Operations, 287
WHITTAKER, LORIN D Tumors Ventral to the Sacrum, 96
WILLARD, DEFOREST P Giant Cell Tumor of the Cervical Spine, 298
WILLIAMS, CARRINGTON Abdominal Approach in Repair of Inguinal Hernia, Advantages of, 917
WILLIS, BYRD W Simple Treatment for Empyema in Children, 739
Willis, Circle of, Aneurysms of the, 660
Wound, Gunshot, of Right Iliac Bone, 155, Stab, of Heart, 21 Years After Suture, 311
Wounds, Clean Surgical, Bacterial Flora of, 607
WRIGHT, DAVID G Treatment of Hemorrhage and Traumatic Shock by Intravenous Use of Lyophile Serum, 500

WYATT, THOMAS E Argentaffine Tumors of Gastro-intestinal Tract, 260

Y

YASKIN, JOSEPH C Brain Abscess of Undetermined Etiology, 492

Z

Zinc Peroxide in Foul Smelling Mouth and Neck Infections, Prophylactic and Active Use of, 32

ZWEMER, RAYMUND L Acute Intestinal Obstruction, 161

ANNALS of SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

Also the Official Publication of the American Surgical Association, the Southern Surgical Association, Philadelphia Academy of Surgery, and New York Surgical Society

VOLUME 107

JANUARY—JUNE

1938

J B LIPPINCOTT COMPANY, Publishers

PHILADELPHIA MONTREAL LONDON NEW YORK

COPYRIGHT 1938
J B LIPPINCOTT COMPANY

MADE IN THE UNITED STATES OF AMERICA

CONTRIBUTORS TO VOLUME 107

	PAGE
ABELL, IRVIN, Louisville, Ky	641
ADAMS, WILLIAM E, Chicago, Ill	359
ADKINS, ELMER H, Miami, Fla	832
ALEXANDER, WILLIAM F, St Louis, Mo	25
ALLEN, ARTHUR W, Boston, Mass	770, 1039
ALTEMEIER, WILLIAM A, Detroit, Mich	517, 634
ARCHIBALD, EDWARD W, Montreal, Can	160
ARIES, LEON J, Chicago, Ill	229
BACON, HARRY E, Philadelphia, Pa	1022
BAGLEY, JR, CHARLES, Baltimore, Md	681
BALFOUR, DONALD C, Rochester, Minn	315
BARKER, M HERBERT, Chicago, Ill	899
BARNEY, J DELLINGER, Boston, Mass	636
BAUMEISTER, CARL, Council Bluffs, Iowa	153
BEALL, FRANK C, Fort Worth, Texas	238
BISHOP, GEORGE H, St Louis, Mo	270
BLACK, WILLIAM T, Memphis, Tenn	855
BLISS, RAYMOND W, El Paso, Texas	242
BLOCK, FRANK B, Philadelphia, Pa	511
BOND, DOUGLAS D, Philadelphia, Pa	500
BRADFORD, F KEITH, Chicago, Ill	107
BRADFORD, F KEITH, Louisville, Ky	708
BRANCH, CHARLES D, Peoria, Ill	475
BRENIZER, ADDISON G, Charlotte, N C	692
BROWN, JAMES BARRETT, St Louis, Mo	952
BROWNSON, KNEALE M, Detroit, Mich	566
BULLOCK, WALLER O, Lexington, Ky	996
BUSH, JASPER D, Decatur, Ala	1029
BUTSCH, WINFIELD L, Rochester, Minn	540
CAROTHERS, RALPH G, Cincinnati, Ohio	980
CAVE, HENRY W, New York, N Y	806
CHILD, CHARLES G, New York, N Y	618
COHN, ISIDORE, New Orleans, La	716
COLEMAN, F P, Cleveland, Ohio	481
COLP, RALPH, New York, N Y	74
CONWAY, FRANCIS M, New York, N Y	627
COURVILLE, CYRIL B, Los Angeles, Calif	371
CRILE, GEORGE, Cleveland, Ohio	909
DANDY, WALTER E, Baltimore, Md	654
DAVID, VERNON C, Chicago, Ill	801
DAVIS, HERBERT H, Omaha, Nebr	207
DAVIS, LOYAL, Chicago, Ill	899
DAVISON, MARSHALL, Chicago, Ill	229
DUDLEY, GUILFORD S, New York, N Y	55
DWIGHT, RICHARD W, Boston, Mass	400

	PAGE
EASTON, E R, New York, N Y	303
EBERHARD, THEODORE P, New York, N Y	380
EGGERS, CARL, New York, N Y	50
FALLIS, LAWRENCE S, Detroit, Mich	572
FINE, JACOB, Boston, Mass	1
FOWLER, ROYAL H, Newark, N J	529
FRANK, L WALLACE, Louisville, Ky	745
FREHLING, STANLEY, Boston, Mass	1
FURCOLO, CHARLES L, Springfield, Mass	25
GAMBLE, HUGH A, Greenville, Miss	701
GARLOCK, JOHN H, New York, N Y	82
GILCHRIST, R KENNEDY, Chicago, Ill	801
GILCREEST, EDGAR LORRINGTON, San Francisco, Calif	988
GILL, A BRUCE, Philadelphia, Pa	122
GEBAUER, P W, Cleveland, Ohio	481
GERSTER, JOHN C A, New York, N Y	783
GLENN, FRANK, New York, N Y	618
GRAHAM, GEORGE S, Birmingham, Ala	1029
GRANT, FRANCIS C, Philadelphia, Pa	14, 492
GROFF, ROBERT A, Philadelphia, Pa	492
HAGGARD, WILLIAM D, Nashville, Tenn	480
HAIGHT, CAMERON, Ann Arbor, Mich	218
HARGENS, C W, Hot Springs, S Dak	153
HEATON, LEONARD D, Ft Warren, Wyoming	242
HEINBECKER, PETER, St Louis, Mo	270
HENDERSON, MELVIN S, Rochester, Minn	132
HERMANSON, LOUIS, Boston, Mass	1
HEUER, GEORGE J, New York, N Y	618
HEYD, CHARLES GORDON, New York, N Y	319
HIRSHFELD, JOHN WINSLOW, New Haven, Conn	607
HOLDEN, GERRY R, Jacksonville, Fla	875
HOWE, M ELIZABETH, New York, N Y	39
HUGHES, JOSEPH, Philadelphia, Pa	640
HURWITT, E S, Boston, Mass	287, 438
IVES, JR, HOWARD ROLLIN, New Haven, Conn	607
JACQUES, EUGENE ST, Montreal, Canada	311
JONES, JOHN F X, Philadelphia, Pa	311
KENNEDY, ROBERT H, New York, N Y	419
KEPLER, EDWIN J, Rochester, Minn	881
KEYES, HAROLD BROWN, New York, N Y	602
KLEIN, SAMUEL H, New York, N Y	82
KLINGENSTEIN, PERCY, New York, N Y	147
KOLODNY, ANATOLE, New York, N Y	128
KUNTZ, ALBERT, St Louis, Mo	25
LAZARUS, JOSEPH A, New York, N Y	278
LINTON, ROBERT R, Boston, Mass	582
LOWER, WILLIAM E, Cleveland, Ohio	923

	PAGE
MAGE, SIGMUND, New York, N Y	155, 472
MAHORNER, HOWARD R, New Orleans, La	927
MAJOR, ROBERT CARLISLE, New Orleans, La	753
MARBURY, WILLIAM B, Washington, D C	819
MARTIN, HAYES E, New York, N Y	39
MASON, JAMES M, Birmingham, Ala	1029
MASSON, CLEMENT B, New York, N Y	20
MASTIN, E VERNON, St Louis, Mo	972
MATAS, RUDOLPH, New Orleans, La	660
MAYO, CHARLES W, Rochester, Minn	540
MCCREERY, JOHN A, New York, N Y	350
MCEWAN, DUNCAN, Orlando, Fla	473
MCEWAN, JOHN S, Orlando, Fla	473
MCGRAW, ARTHUR B, Detroit, Mich	198
MCKIRDIE, MATTHEW, Iowa City, Iowa	389
MELENEY, FRANK L, New York, N Y	32
MICHAEL, MAURICE A, Philadelphia, Pa	511
MISCALL, LAURENCE, New York, N Y	55
MORSMAN, C F, Hot Springs, S Dak	153
NEWBURGER, BERNHARD, Cincinnati, Ohio	558
NICHOLSON, JESSE THOMPSON, Philadelphia, Pa	298
O'BRIEN, JOHN D, Canton, Ohio	486
OCHSNER, ALTON, New Orleans, La	927
OCHSNER, EDWARD H, Chicago, Ill	829
OLNEY, MARY B, Chicago, Ill	359
OUTLAND, TOM A, Sayre, Pa	116
PEMBERTON, JOHN DEJ, Rochester, Minn	96
PENBERTHY, GROVER C, Detroit, Mich	566
PENNOYER, GRANT P, New York, N Y	543
PRESTON, ROBERT L, New York, N Y	319
PREWITT, PROVISO V, New York, N Y	303
RANKIN, FRED W, Lexington, Ky	644
RIVES, JAMES DAVIDSON, New Orleans, La	753
ROGERS, HORATIO, Boston, Mass	400
ROMANO, SAMUEL ANDREW, New Orleans, La	753
ROWE, STUART N, Pittsburgh, Pa	620
ROYSTER, HUBERT A, Raleigh, N C	878
SANDERS, ROBERT L, Memphis, Tenn	863
SCHOFIELD, JAMES D, Philadelphia, Pa	1022
SCUDDER, JOHN, New York, N Y	161
SHEPHERD, WALTER F, Sayre, Pa	116
SHIPLEY, ARTHUR M, Baltimore, Md	880
SLOAN, HARRY G, Cleveland, Ohio	143
SMITH, BEVERLY C, New York, N Y	321
SPURLING, R GLEN, Louisville, Ky	708
STEIGMANN, ALBERT T, Cleveland, Ohio	486
STENGEL, JR, ALFRED, Philadelphia, Pa	1000
SULLIVAN, JOHN E, New York, N Y	594
SWEET, W H, Boston, Mass	287, 438

	PAGE
TAYLOR, FREDERIC W, Indianapolis, Ind	458
TODYO, T, Kogoshima, Japan	340
TORMEY, JR, THOMAS W, Cleveland, Ohio	923
TOUROFF, ARTHUR S W, New York, N Y	469
TROUT, HUGH H, Roanoke, Va	733
TURNER, PAUL, Louisville, Ky	745
TYRONE, CURTIS H, New Orleans, La	836
VANBEUREN, JR, FREDERICK T, New York, N Y	321
WAGNER, DAVID H, Chicago, Ill	1005
WALTERS, WALTMAN, Rochester, Minn	881
WATTS, STEPHEN H, University Va	873
WEINSTEIN, MANDEL, Long Island City, N Y	248
WHARTON, LAWRENCE R, Baltimore, Md	842
WHIPPLE, ALLEN O, New York, N Y	161
WHITE, J C, Boston, Mass	287, 438
WHITELAW, G P, Boston, Mass	287
WHITTAKER, LORIN D, Rochester, Minn	96
WILLARD, DEFOREST P, Philadelphia, Pa	298
WILLIAMS, CARRINGTON, Richmond, Va	917
WILLIS, BYRD CHARLES, Rocky Mount, N C	739
WRIGHT, DAVID G, Philadelphia, Pa	500
WYATT, THOMAS E, Nashville, Tenn	260
YASKIN, JOSEPH C, Philadelphia, Pa	492
ZWEMER, RAYMUND L, New York, N Y	161

CONTRAST MEDIA VARY IN EFFECTIVENESS AS STARS VARY IN BRILLIANCE



LIPIODOL (LAFAY)* FOR PRECISE SHARP RADIOGRAPHS

These briefly are the eight essential features of Lipiodol (Lafay)

1 The original French iodized oil
2 Not a chloro iodized oil—contains no chlorine
3 Light amber color—helps detect deterioration
4 Bland and well tolerated even by delicate tissues
5 Relatively non irritating and non toxic
6 Precise clear cut sharply outlined radiographs
7 Facilitates diagnosis of many obscure conditions
8 Reveals pathologic conditions which ordinary radiographs cannot visualize

Iodized Poppy Seed Oil 40

LIPIODOL (LAFAY)

Important New Publications

NEW (3d) EDITION *JUST READY*

DISEASES OF THE THYROID, PARATHYROIDS and THYMUS

By ANDRE CROTTI, M D , F A C S , LL D , R I C S

Formerly First Assistant of the Pathological Laboratory at the University of Lausanne Switzerland, Surgical Assistant at Roux's Clinic, Lausanne, Switzerland, and at Kocher's Clinic Berne, Switzerland Formerly Associate Professor of Anatomy and Professor of Clinical Surgery at Ohio State University, Columbus, Ohio, Etc

Imperial octavo, enlarged and thoroughly revised 1229 pages, illustrated with 262 engravings and 39 colored plates Morocco, de luxe edition $20 00 net

This new edition of Dr Crotti's famous work is practically a new book Nearly four hundred pages have been added, together with many new illustrations The series of thirty-nine colored plates are masterpieces of the printer's art and greatly enhance the value of the work Dr Crotti has devoted his life to specialization in goiter pathology, both in this country and in his native Switzerland His research work has been extensive and his conclusions on the various thyroid problems are based on his unusual experience which includes over eighteen thousand non-surgical goiter cases and nine thousand thyroidectomies The new material contained in this edition includes a thorough survey of the parathyroids which are assuming increasing importance and which are closely related to the thyroid There are new chapters on the relationship of the thyroid to the autonomic nervous system on goiter fungus and the author's research work in the establishment of the etiology of the endemic goiter

There is no single volume available that contains such a thorough discussion of the thyroid and thymus glands and their diseases In the interval which has elapsed since the appearance of the second edition of this book there have been many advances in this field All of them are reflected in this edition The question of goiter is treated broadly not only in theory but also from the point of view of operative treatment as well Of the fifty-one chapters that compose the book fifty are devoted to the study of the thyroid gland which is treated from every possible angle An excellent balance is maintained between the fundamental scientific aspects and the strictly practical considerations The technique of operation in different types of goiter the pitfalls and dangers that await the surgeon and the methods of meeting various complications are clearly described and illustrated This work is written not only for the surgeon but for the entire medical profession

NEW (3d) EDITION *JUST READY*

A TEXT-BOOK OF PATHOLOGY

By WILLIAM BOYD, M D , LL D , M R C P (Ed), F R C P (Lond), Dipl Psych , F R S C

Professor of Pathology and Bacteriology in the University of Toronto Toronto Formerly Professor of Pathology in the University of Manitoba Winnipeg, Canada

Octavo, 1064 pages, illustrated with 459 engravings and 16 colored plates Cloth, $10.00, net

Much new material has been added to cover the many advances in this field since the previous edition appeared To avoid materially increasing the size of the volume and to add to the convenience of the reader, the clinical sections covering symptoms and the relation of symptoms to lesions have been printed in small type A section on sudden death has been added the anemias and the pneumonias have been reclassified and the general discussion of the viruses has been rewritten Many new illustrations have been included

There is an abundance of other new material including experimental pulmonary embolism, the direct observation of repair in living tissue, the method of invasion in typhoid fever, the pathogenesis of acute pancreatitis, the relation of the anaerobic streptococci to disease the etiology of arteriosclerosis the reaction of the inflammatory exudate, the Duran-Reynals phenomenon, tuberculosis of the stomach, lymphadenoid goiter, utero-placental apoplexy, plasma-cell mastitis, Brenner's tumor, dermatomyositis regional ileitis, meconium ileus and adenoma of bronchus

LEA & FEBIGER

WASHINGTON SQUARE
PHILADELPHIA, PA

Please send me books checked

☐ Crotti on The Thyroid Parathyroids and Thymus $20 00 ☐ Boyd's Text-Book of Pathology $10 00

Name Address

(A of S 6 38)
18

Please mention ANNALS OF SURGERY when writing advertisers



Enjoy the Comfort and Prestige of

PHILADELPHIA'S FOREMOST HOTEL

Treat yourself to the best when you visit Philadelphia stop at the Benjamin Franklin Big, comfortable rooms with every modern comfort Enjoy food that's an epic for epicures Save time and annoyance through the Benjamin Franklin's convenient location Yet all this costs you no more than ordinary hotel comfort and service

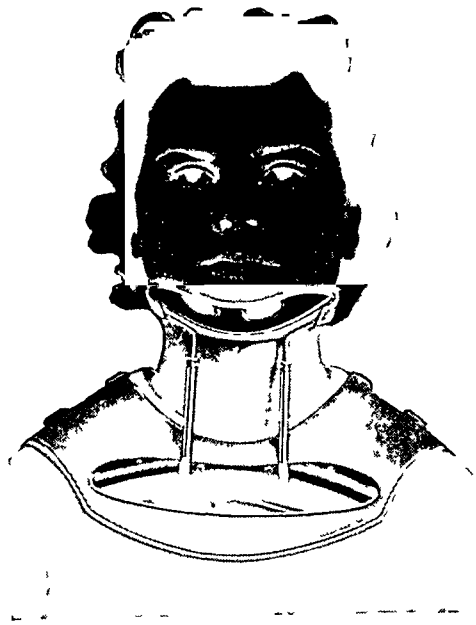


The

BENJAMIN FRANKLIN

PHILADELPHIA'S FOREMOST HOTEL

Samuel Earley · MANAGING DIRECTOR



FORRESTER CERVICAL COLLAR

Two adjustable chin and head supports permit elevation and extension Comfortable, especially desirable for women

Write for Fracture Book

DePuy MFG CO, WARSAW, IND

Cook County Graduate School of Medicine

(IN AFFILIATION WITH COOK COUNTY HOSPITAL)

Incorporated not for profit

ANNOUNCES CONTINUOUS COURSES

MEDICINE—Two Weeks Intensive Course starting June 20th Electrocardiography every month Special Courses during August

SURGERY—General Courses One Two, Three and Six Months, Two Weeks' Intensive Course in Surgical Technique with practice on living tissue, Clinical Course, Special Courses Courses start every Monday

GYNECOLOGY—Personal Courses June 13th August 22nd Gynecological Pathology by Dr Schiller starting July 25th Two Weeks' Course starting October 10th

OBSTETRICS—Two Weeks Intensive Course starting October 24th Informal Course starting every week

FRACTURES & TRAUMATIC SURGERY—Informal Course Intensive Formal Course starting October 10th

UROLOGY—One Month Course Two Weeks Course starting every two weeks

CYSTOSCOPY—Ten-Day Practical Course rotary every two weeks

General Intensive and Special Courses in all branches of Medicine Surgery and the Specialties every week

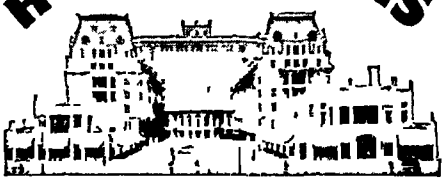
TEACHING FACULTY

Attending Staff of Cook County Hospital

Address Registrar 427 South Honore Street Chicago Illinois

Doctor! TRY THE

HOTEL DENNIS
WALTER J BUZBY, INC



ATLANTIC CITY

and you'll recommend it to your patients When you must get away for a change and a little diversion, come to the Hotel Dennis Get acquainted with the advantages of this modern, beachfront hotel and its wonderful location for those patients who need rest, diet, health baths, sunshine and cool sea breezes

For any season, you can enjoy and recommend the luxurious suites, sundecks, solaria and the famous Dennis cuisine American and European plans Rates moderate

Write for folder describing the Dennis Diet Kitchens and Health Baths

Features of Interest to Your Patients

Diet Kitchen in charge of Expert Dietitian

Special Kitchen for use of private nurses

Therapeutic Baths, modern and complete

Sun Decks and Solaria

Numerous Nooks for quiet lounging

HOTEL DENNIS

On the Ocean at Michigan Ave , 3 Blocks from Union Station & Auditorium

Ready Soon!

"There is no finer book on the subject"

Dr Bacon s new book is comprehen sive, practical and authoritative It offers an unbiased, informative descrip tion of the diversified conditions included in proctologic practice, and covers every phase of the subject It emphasizes the application of the procedure to the pa tient—not the patient to the procedure *487 illustrations (mostly originals) crisply picture the author's wide clinical and surgical experience*

Dr Bacon s text stresses the underlying pathology of the Anus, Rectum and Sigmoid Colon as basic to treatment He describes the various methods of exami nations Diseases are detailed, giving Definition, Etiology, Symptoms, Diagnosis, Medical and/or Surgical Treatment Particular attention is given to Hemorrhoids and to Tumors, including infectious, benign and malignant tumors of the sigmoid and rectum A comprehen sive, selected bibliography completes each chapter 600 pages 487 illustrations

$8 50

ANUS, RECTUM AND SIGMOID COLON

Diagnosis and Treatment by

HARRY E. BACON, M.D.

F A C S , F A P S , Assistant Professor of Proctology, Temple University School of Medicine, Associate in Proctology, Graduate School of Medicine, University of Pennsylvania

Foreword by

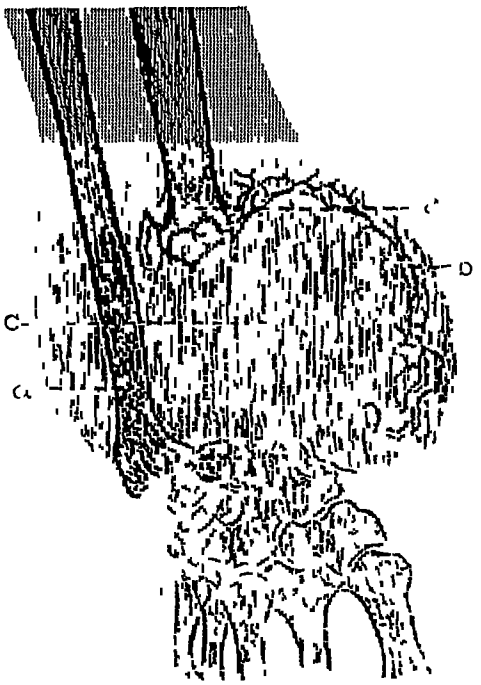
J P LOCKHART MUMMERY, M A M B B Ch (Cantab), F R C S (Eng), Emeritus Surgeon, St Mark s Hospital London, England

Published by

J. B. LIPPINCOTT COMPANY

Washington Square Philadelphia

Just What Every Doctor Has Wanted



One of the unique drawings of the artist, Jean E Hirsch, who uses an entirely new method to illustrate diseases of the bones and joints

ON ROENTGEN DIAGNOSIS

TO speed up your ability to accurately diagnose conditions through the roentgen-ray method, Dr Leo G Rigler has covered this very extensive subject in an illustrated outline form that is admirably suited to everyday practice The indications, possibilities and limitations of the roentgen method of diagnosis are clearly stated The relative value of roentgen diagnosis in each disease process is definitely presented

Illustrations total 227 figures, but roentgenograms which serve to illustrate several conditions are frequently used, thus increasing their practical utility far beyond their actual number All are shown as negatives to save you the burden of reinterpretation The artist, Jean E Hirsch, has used a unique, new technique to illustrate the diseases of the bones and joints Her method permits accentuation of important points or composite figuring of several cases The entire book has been used in mimeograph form in lecturing to general practitioners as well as students, and has already emphatically proved its usefulness The book complete, with 227 illustrations and x-rays grouped in atlas fashion is only $6 50 (Slightly higher in Canada) Ready June 15th

TABLE OF CONTENTS:

The book has been divided into eleven sections, as follows

I General Principles of Roentgen Diagnosis
II Bones and Joints
III Diseases of Spine and Spinal Cord
IV Skull and Its Contents
V Thorax
VI Digestive Tract
VII Gall Bladder
VIII Abdomen
IX Urinary Tract
X Female Generative
XI Miscellaneous

OUTLINE OF ROENTGEN DIAGNOSIS

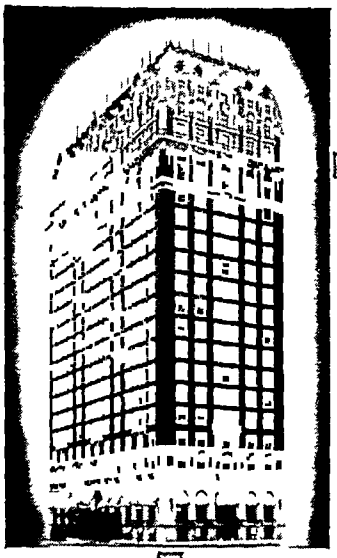
An Orientation in the Basic Principles of Diagnosis by the Roentgen Method

by Leo G. Rigler, B.S., M.B., M.D.

Professor of Radiology, University of Minnesota, Minneapolis

Medical Arts Bldg, Montreal **J. B. LIPPINCOTT COMPANY** *Washington Square, Philadelphia*

Please mention ANNALS OF SURGERY when writing advertisers



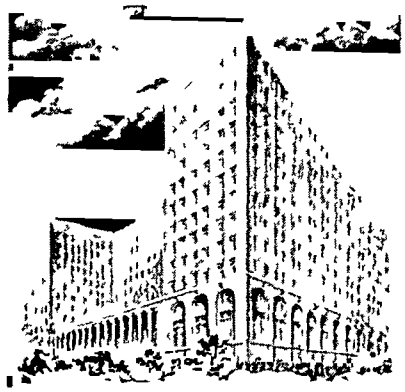
For a Perfect Vacation

Enjoy Chicago's outstanding program of summer sports and entertainment while living in the midst of beautiful surroundings at Chicago's Finest Hotel

A S Kirkeby, *Managing Director*

The Blackstone

MICHIGAN AVENUE CHICAGO



For A Perfect Vacation

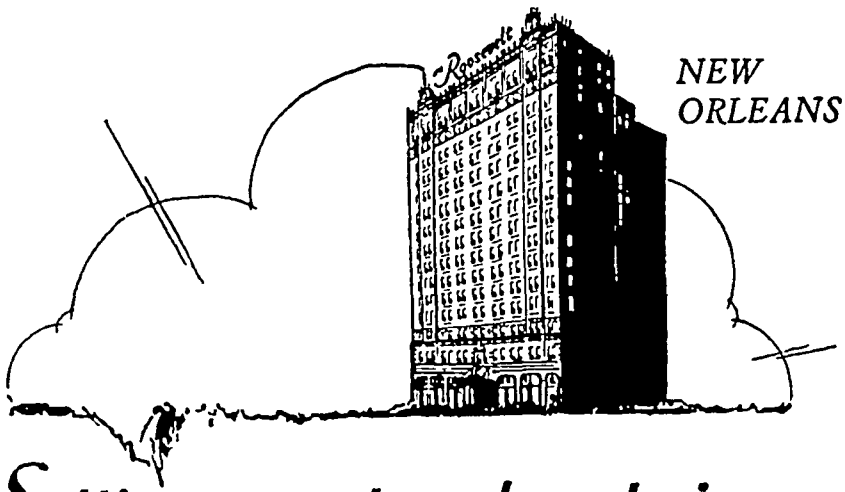
Enjoy Chicago's unequaled program of summer sports and luxurious living in the cooling breezes of Lake Michigan, at The Drake

A S Kirkeby, *Managing Director*

The Drake

LAKE SHORE DRIVE • CHICAGO

Please mention ANNALS OF SURGERY when writing advertisers



Setting a standard in

HOTEL ACCOMMODATIONS

Leadership always carries with it the obligation to be more, to do more and give more

As applied to The Roosevelt, New Orleans, leadership means a completely equipped hotel where the traveler finds refinements and luxuries that add so much to the comfort and pleasure of his stay It means better accommodations and service, and finer food for the dollars you spend 800 rooms with bath Moderate rates

Write or Wire Reservations
JAS PAT O'SHAUGHNESSY V-P & Gen Mgr

Order Pralines by Mail

Full halves of selected Louisiana Pecans in a luscious layer of pure Louisiana Cane Sugar New Orleans famous Candy made from the recipe of the Old Plantation Mammy Two attractive gift boxes



Souvenir Cotton Bale Package, 10 Pralines for $1 75 Postage paid
Plantation Mammy Package, 12 Pralines $1 50 Postage paid
Send Money Order or personal check with order to *The Roosevelt Hotel,* New Orleans

The Roosevelt
HOTEL
Pride of the South.



Uniform-fixed Viscosity

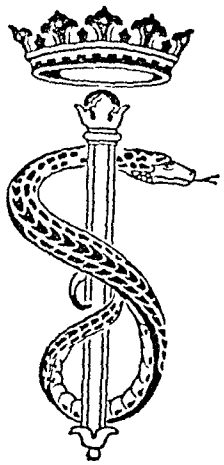
Viscosity is an important physical property of vaginal jellies It should be uniform and fixed within a desirable range The viscosity of Ortho-Gynol is determined by a dart penetrometer at 40° C At this temperature the desirable range was found to be 58-62 mm This viscosity range is maintained, with average determination approximating 60 mm

Ortho-Gynol is recommended and prescribed regularly by thousands of physicians

A PRODUCT OF JOHNSON & JOHNSON

COPYRIGHT 1938 JOHNSON & JOHNSON

A SURGEON'S INVESTMENT



TRADE MARK

When a surgeon reaches earning power he has made quite an investment in time and money

This investment is made in search for greater skill and higher efficiency

Instruments bought on price have no place in this investment

The surgeon can have the finest instruments, but he will get no better than he demands

The slight additional cost for Kny-Scheerer instruments is fully justified in the service

SPECIFY AND INSIST ON THE MAKE OF INSTRUMENTS THAT SUPPORT YOUR INVESTMENT

Our DeLuxe catalog is the standard reference book Ask your dealer for a copy

KNY-SCHEERER CORPORATION

[THE QUALITY HOUSE]

21-09 Borden Avenue, Long Island City, N Y

FORTY-SIXTH YEAR

Gray's Glycerine Tonic Comp.

(Formula Dr John P Gray)

Glycerine, Sherry Wine, Gentian, Taraxacum
Phosphoric Acid, Carminatives

Will provide the Physician with a dependable all year round Tonic It is of especial value in Spring and Summer ailments

TWENTY-SEVENTH YEAR

HYPEROL

a Utero-Ovarian Tonic and Corrective, has proved of consistent value in the treatment of Functional Diseases of Women

Formula Hydrastine, Aloin, Iron (Blauds Mass), Quinine and Apiol

Samples to Physicians on request

THE PURDUE FREDERICK CO , 135 Christopher St , New York City



WHATEVER the influences that cause insomnia, DIAL "Ciba" brings forgetfulness through its effective hypnotic properties Sound, restful sleep comes and soon the dreaded night is past Morning usually finds the patient in a more cheerful frame of mind.

Wherever there is need for a good hypnotic or sedative, DIAL* (diallylbarbituric acid) is indicated—in nervous insomnia, mental and traumatic agitation, pre-anesthetic sedation, etc Solution of DIAL with Urethane is suggested when intramuscular administration is desirable as in obstetrical analgesia.

* Trade Mark Reg U S Pat Off

Dial
"Ciba"

TABLETS ELIXIR • POWDER AMPULES

CIBA PHARMACEUTICAL PRODUCTS INC
SUMMIT NEW JERSEY

LOESER'S INTRAVENOUS SOLUTION
of
IRON AND ARSENIC

A sterile standardized solution containing 64 milligrams of Colloidal Iron Cacodylate in 5 c c hermetically sealed ampoules.

Hemotonic therapy is no longer empirical treatment Recent investigations have firmly established the rationale of Iron therapy.

Post surgical anemias offer exceptional opportunity for demonstrating the more effective and scientific method of therapy. Prompter and more certain results are assured

Literature on Request

LOESER LABORATORY, Inc.

22 West 26th St. New York City